

City of Tulare

Industrial WWTP Dewatering Project Technical Specifications

Volume 2 of 3

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City of Tulare

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SECTION 01 01 00

SCHEDULE OF WORK

PART 1 GENERAL

1.1 GENERAL

- A. This section includes information from the General Conditions about the timing and schedule of the work.

1.2 RELATED SECTIONS

- A. The following Sections are related to the work in this Section.
 - 1. Section 01 11 10 Summary of Work
 - 2. Section 01 11 10 Coordination of Work
 - 3. Section 01 14 00 Work Restrictions

1.3 BEGINNING OF WORK

- A. The Contractor shall begin work within ten (10) working days after receipt of official Notice to Proceed from the Owner.

1.4 TIME OF COMPLETION

- A. The Contractor shall substantially complete all work within eighty (80) working days unless the period for completion is extended otherwise by the Contract Documents. The work shall be finally complete within an additional thirty (30) calendar days. The Contractor shall diligently prosecute the work to completion on or before the completion date indicated on the Notice to Proceed.

1.5 TIME CONSTRAINTS

- A. Contractor shall supervise, inspect, and direct the Work competently and apply such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the specific means, methods, techniques, sequence, or procedure of construction required to complete the project as specified by the Contract Documents. Contractor shall be responsible to see that the completed Work complies accurately with the Contract Documents.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

SCHEDULE OF WORK
01 01 00-1

END OF SECTION

SCHEDULE OF WORK
01 01 00-2

SECTION 01 11 00

SUMMARY OF WORK

PART 1 GENERAL

1.1 GENERAL

- A. This section summarizes the work included in the Contract Documents.

1.2 RELATED SECTIONS

- A. The following Sections are related to the work in this Section.
1. Section 01 01 00 Schedule of Work
 2. Section 01 11 10 Coordination of Work
 3. Section 01 14 00 Work Restrictions

1.3 WORK INCLUDED

- A. The Work consists of furnishing all labor, materials and equipment necessary to construct a new solids-dewatering facility, in the City of Tulare, in accordance with the Plans and the Specifications.
- B. The primary components are generally described as follows:
1. Demolition and clearing; site grading; aggregate base; concrete foundations, yard piping; dewatering system installation; polymer storage system; and electrical and control systems.

1.4 LOCATION OF PROJECT

- A. The work will be completed at the City of Tulare WWTP located at 1875 South West Street, Tulare, CA 93274.

1.5 ACTIVITIES BY OTHERS

- A. The Owner will continue to operate the WWTP during completion of the work. See Section 01 14 00 for restrictions on impact to ongoing operations.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SUMMARY OF WORK
01 11 00-1

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SECTION 01 11 10

COORDINATION OF WORK

PART 1 GENERAL

1.1 GENERAL

- A. This section includes information from the General Conditions about the timing and schedule of the work.

1.2 RELATED SECTIONS

- A. The following Sections are related to the work in this Section.
 - 1. Section 01 11 00 – Schedule of Work
 - 2. Section 01 11 10 – Summary of Work
 - 3. Section 01 14 00 – Work Restrictions

1.3 RESPONSIBILITY OF CONTRACTOR

- A. If any part of the Work depends for proper execution or results upon the work of others, the Contractor shall inspect and promptly report to the Engineer any apparent discrepancies or defects in such work of others that render it unsuitable for such proper execution and results. Failure of the Contractor to so inspect and report shall constitute an acceptance of the work of others as fit and proper except as to defects which may develop in the work of others after execution of the Work by the Contractor.

1.4 WORK INVOLVED WITH EXISTING SYSTEM

- A. Existing materials and equipment removed not designated to be salvaged for Owner in the execution of the Work shall become the property of the Contractor and shall be removed from, and disposed of, off the site by the Contractor in an acceptable and lawful manner.

1.5 COORDINATION OF WORK

- A. The Contractor shall maintain overall coordination for the execution of the Work. Based on the Construction Schedule prepared in accordance with these Specifications, he shall obtain from each of his subcontractors a similar schedule and shall be responsible for all parties maintaining these schedules or for coordinating required modifications.

END OF SECTION

COORDINATION OF WORK
01 11 10-1

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SECTION 01 14 00

WORK RESTRICTIONS

PART 1 GENERAL

1.1 SUMMARY

- A. This section includes requirements and sequencing of the work affecting existing facilities.

1.2 RELATED SECTIONS

- A. The following Sections are related to the work in this Section.
 - 1. Section 01 01 00 Schedule of Work
 - 2. Section 01 11 00 Summary of Work
 - 3. Section 01 11 10 Coordination of Work
 - 4. Section 01 50 00 Temporary Facilities
 - 5. Section 40 05 00 Pipe and Fittings

1.3 GENERAL CONSTRAINTS

- A. The WWTP is a critical piece of infrastructure for the Owner's wastewater system. The work shall be conducted in such a way that it does not impede the Owner from complying their Waste Discharge Requirements or operational requirements.
- B. Startup and adjusting activities shall not impede the Owner operating the WWTP.
- C. The work shall generally be completed between the hours of 7:00 am and 7:00 pm unless approved by the Owner.

1.4 SHUTDOWN CONSTRAINTS

- A. The work shall not interfere with the operation of the WWTP and must be completed while the WWTP is in operation and shall be organized to minimize the number of shutdowns required.
- B. The Contractor shall submit a shutdown plan including the work to be completed and the time, date and duration of any proposed shutdown at least 48 hours prior.
- C. The Contractor shall be allowed to shut down the digested solids wasting line for up to 12 hours while making piping connections. Any shutdown longer than 12 hours shall require temporary piping be installed to allow the digesters to waste solids throughout the day.
- D. The Owner shall have sole authority to approve a shutdown and retains the ability to cancel an approved shutdown if necessary.

WORK RESTRICTIONS
01 14 00-1

1.5 REQUIREMENTS FOR OPERATION OF EXISTING FACILITIES

- A. Contractor is responsible to provide temporary facilities as needed to keep the WWTP systems continuously operational.
- B. Permanent facilities used to maintain continuous operation of the facilities during construction shall be tested as required in 40 05 00.
- C. Maintain electrical power to the site including transformers, distribution wiring, and motor controls centers. Electrical equipment shall be protected in place unless specifically noted otherwise on the drawings.

1.6 OWNER'S ACCESS

- A. Contractor shall maintain safe access to the sites for the Owner at all times.

1.7 UTILITIES

- A. New yard piping and utilities were designed based on existing facility drawings and discussions with operations personnel. No field verification or potholing was completed during design. It is the Contractors responsibility to verify the location, depth, size, and material of existing utilities.
- B. Contractor shall utilize Underground Service Alert (USA) for location and marking of underground utilities in the vicinity of the work.

1.8 WORK SEQUENCE

- A. The following work sequence is only an example of a possible sequence for the work and does not require or restrict the Contractor. The description is not intended to describe all items but only critical events necessary to minimize shutdowns.
- B. The dewatering equipment is in fabrication will be ready to be shipped to the site.

1. Dewatering Work Sequence

- a. Locate and expose the existing dewatered sludge line in the project area.
- b. Coordinate with the Owner to draw down the digesters the extent possible without impacting performance.
- c. Isolate and drain the existing sludge line into one of the nearby solids drying beds.
- d. Install the new piping and valving and pressure test the new piping.
- e. Set the dewatering valve to closed and the dewatering bypass valve to open and allow flow back into the digested solids line and out to the drying beds.
- f. Complete the rest of the work.

WORK RESTRICTIONS
01 14 00-2

City of Tulare
Industrial WWTP Dewatering Project

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

WORK RESTRICTIONS
01 14 00-3

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SECTION 01 22 00 EXPLANATION OF BID ITEMS

PART 1 GENERAL

The Contract payment for the specified items of work as set forth in the Bid Schedule shall be full compensation for furnishing all labor, materials, methods or processes, implements, tools, equipment and incidentals and for doing all work involved as required by the provisions of the Contract Documents for a complete in place and operational system.

- A. Unless otherwise specified in the Specifications, quantities of work shall be determined per each, or from measurements or dimensions in a horizontal plane. All materials shall be measured on the basis of "in place" quantities and paid for using the units listed in the bid schedule.
- B. Except as noted, the Engineer will make field measurements of unit price items in order to determine the quantities of the various items as a basis for payment. On all unit price items, the contractor will be paid for the actual amount of the work performed in accordance with the contract documents, as computed from field measurements.
- C. Work or quantities not listed in the description of bid items are considered incidental to other construction and will not be separately measured or paid for. Compensation for such work and/or material shall be included in the prices paid for other items of work.

1.2 BID ITEMS DESCRIPTIONS

Bid Item 1 – **General Provisions, Mobilization, Bonds and Insurance:** Payment for this item shall include full compensation for all labor, materials, tools, equipment and incidentals making up the cost of mobilization, move-in, move-out, all necessary bonds, insurance, permits, licenses, and fees required during the performance of the work as specified. This item also includes demobilization, including the removal of all equipment, supplies, personnel and incidentals from the project at the end of construction and any other cost due to requirements in the General Provisions. Payment shall not exceed \$50,000. Payment for mobilization shall be made with the first progress payment and shall not exceed 80 percent of the bid item amount. Payment for demobilization shall be made with the last progress payment and shall not be less than 20 percent of the bid item amount.

Bid Item 2 – **Dust Control:** Payment under this item shall be considered full compensation for all labor, materials, tools, equipment and incidentals required to perform dust control measures for the project limits in accordance with these specifications. This bid item will be paid for by Lump Sum, prorated, based on percentage of contract work completed.

Bid Item 3 – **Worker Protection:** This bid item is a lump sum bid for providing worker protection from trench failures and other hazards that may occur during construction. The Contractor shall comply with the provisions of the Construction Safety Orders, Tunnel Safety Orders, and General Safety Orders issued by the State of California of Industrial

EXPLANATION OF BID ITEMS
01 22 00-1

Safety, as well as all other applicable laws, ordinances, and regulations, as they pertain to the protection of workers from the hazard of caving ground. The Contractor shall obtain a permit from the Division of Industrial Safety of the State of California prior to commencement of construction. This bid item shall be paid as a lump sum, prorated based on the percentage of contract work completed.

Bid Item 4 – **Demolition, Clearing and Grubbing:** Payment for this item shall include full compensation for all labor, materials, tools, equipment and incidentals making up the cost of all work involved in clearing, grubbing, tree removal, and demolition within the project site, including the protection of existing utility poles in-place during construction, all as described in the Plans and Specifications. This bid item will be paid as a lump sum, prorated based on the percentage of this item completed.

Bid Item 5 – **Site Grading:** This bid item includes rough and finish grading, import material and all labor and equipment required to complete the grading of the site including over excavation under all concrete slabs and compaction of fill material, fill areas and spreading unsuitable material at the end of the job at the direction of the Owner. This bid item will be paid as a Lump Sum, prorated based on the percentage of this item completed.

Bid Item 6 – **6" Class II Aggregate Base Surfacing:** This bid item is unit price bid per square foot for all work associated placing Class 2 Aggregate Base Surfacing on the treatment plant site as shown on the Plans. Work in this bid item shall include, but is not limited to, subgrade preparation, placing and compacting aggregate base to the lines and grades shown on the Plans. This bid item will be paid for by Lump Sum.

Bid Item 7 – **Site Piping:** Payment for this item shall include full compensation for all labor, materials, tools, equipment and incidentals required for all site piping, accessory piping and tubing, pipe supports, backflow preventers, flow meters, emergency eye wash / shower, valves, fittings, and appurtenances. This bid item includes trenching, bedding, and backfill and compaction. Completed item shall provide a complete and fully operational onsite yard piping system. This bid item will be paid for by Lump Sum.

Dewatering Equipment Package has been procured by the Owner. See Section 01 64 00.

Bid Item 8 – **Dewatering Equipment Installation and Testing:** This bid item includes installing the Owner furnished Dewatering Equipment, which include Volute Dewatering Press, Dewatered Solids Conveyor, and the Polymer Makedown System, associated piping, fittings, pipe supports, valves, and appurtenances for proper function of the system as detailed in the bid documents. Completed item shall provide a complete and fully operational solids dewatering system. This bid item will be paid for by Lump Sum.

Bid Item 9 – **Dewatering Equipment and Polymer Storage Foundation:** This bid item includes the construction of foundation concrete for the Dewatering Equipment and Polymer Storage Area, including but not limited to: subgrade preparation, compaction and constructing reinforced concrete foundation, as detailed in the Plans and Specifications. This item shall include full compensation for furnishing all labor, equipment and materials to complete the work as described herein, and no additional compensation will be made therefore. This bid item shall be paid for by Lump Sum.

Bid Item 10 – **Site Concrete:** Payment under this item shall be considered full

EXPLANATION OF BID ITEMS
01 22 00-2

compensation for all labor, materials, tools, equipment and incidentals required to construct sidewalk, retaining walls, equipment pads, concrete driveway and any other miscellaneous concrete to the lines and grades shown and specified. This bid item includes but is not limited to subgrade preparation, compaction and constructing reinforced concrete foundation, as detailed in the Plans and Specifications. This bid item will be paid for by Lump Sum.

Bid Item 11 – **Polymer Storage Tanks:** Payment under this item shall be considered full compensation for all labor, materials, tools, equipment and incidentals required to furnish and install polymer storage tanks and appurtenances as detailed in the Plans and Specifications. This bid item includes chemical tubing, fittings, pipe supports, taps, injection quills, testing, and startup. Completed item shall provide a complete and fully operational polymer storage system. This bid item shall be paid for by Lump Sum.

Bid Item 12 – **Site Electrical, Instrumentation, and Controls:** The bid item price shall include full compensation for furnishing all labor, tools, equipment and materials, along with all associated appurtenances required to complete the site electrical and instrumentation for the installation of the Dewatering System and ancillary equipment. Completed item shall provide a complete and fully operation electrical and communication with the field instruments and devices. This bid item will be paid as a lump sum, prorated based on the percentage of this item completed.

END OF SECTION

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SECTION 01 31 19

PROJECT MEETINGS

PART 1 GENERAL

1.1 SUMMARY

- A. This section includes information about the meetings required as part of the Work including Preconstruction Conference and Progress Meetings.

1.2 RELATED WORK

- A. Section 01 33 00 – Submittal Procedures

1.3 PRECONSTRUCTION CONFERENCE

- A. Upon receipt of the Notice to Proceed, or at an earlier time if mutually agreeable, the Owner will arrange a preconstruction conference to be attended by the Contractor, Contractor's superintendent, the Owner, the Engineer or his representative, and representatives of utilities, major subcontractors, City of Tulare and others involved in the execution of the Work.
- B. The purpose of this conference shall be to establish a working understanding between the parties and to discuss the Construction Schedule, Critical Path Method format required, shop drawing submittals and processing, applications for payment and their processing, and such other subjects as may be pertinent for the execution of the Work.

1.4 PROGRESS MEETINGS

- A. Progress meetings shall be conducted weekly, unless designated otherwise and shall be attended by the Engineer or his representative, Contractor, Contractor's superintendent and representatives of all subcontractors, utilities, and others, that are active in the execution of the Work. The purpose of these meetings shall be to expedite the work of any subcontractor or other organization that is not up to schedule, resolve conflicts, and in general, coordinate and expedite the execution of the Work.
- B. The agenda of progress meetings shall include review of progress and schedule, of payment request, of the latest Construction Schedule update, and of the record documents.
- C. The progress of the Work and the Construction Schedule shall be reviewed to verify:
 - 1. Actual start and finish dates of completed activities since the last progress meeting.
 - 2. Durations and progress of all activities not completed.

3. Reason, time, and cost data for Change Order work that is to be incorporated into the Construction Schedule or payment request form.
4. Payment due to the Contractor based on percentage complete of items in the submitted payment request.
5. Reasons for, and duration of, required revisions in the Construction Schedule.
6. After each update, the Contractor shall submit to the Engineer an updated of the last accepted Construction Schedule.

1.5 REVIEW OF PAYMENT REQUEST

- A. The Contractor shall have his copy of the payment request and all other data required by the Contract Documents completed prior to the progress meeting. The Engineer will process Contractor's payment request after satisfactory review of the schedule update.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED

END OF SECTION

SECTION 01 33 00

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 WORK INCLUDED

- A. The work described in this section includes general requirements and procedures related to the preparation and transmission of submittals to include Shop Drawings, Product Information, Calculations, Test Reports, Certificates, Samples, Manuals, and Record Drawings

1.2 RELATED WORK

- A. Section 01 31 19 – Project Meetings
- B. Individual equipment specifications

1.3 GENERAL

- A. Contractor shall perform the following work tasks before a submittal.
 - 1. Reviewed and coordinated the Submittal with other submittals and with the requirements of the Work and the Contract Documents;
 - 2. Determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
 - 3. Determined and verified the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
 - 4. Determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.
- B. The Contractor may make more than one submittal per specification section; however, no submittal may cover more than one section.
- C. Submittals shall be in PDF format with dividers between each component. Provide hard copies of shop drawings on 11x17 paper size if requested by the Engineer.
- D. All catalog and specification sheets shall be clearly marked to indicate the specific model number and configuration to be used. Items not applicable to the project shall be crossed out.

- E. Show complete and detailed fabrication; assembly and installation details; wiring and control diagrams; catalog data; pamphlets; descriptive literature; and performance and test data.
- F. Include calculations or other information sufficient to show comprehensive description of structure, equipment, or system provided and its intended manner of use.
- G. Include Manufacturer's installation recommendations.
- H. Furnish neat, legible, and sufficiently explicit detail to enable proper review for Contract compliance.
- I. All submittal information shall be in English with customary American units unless specified otherwise in the individual technical specification sections.
- J. Contractor assumes all risks of error and omission.
- K. Work performed before Engineer's review, or not conforming to reviewed submittals, shall be at Contractor's risk.
- L. Submittal requirements contained in this specification are in addition to specific submittal requirements contained in individual equipment specification sections.

1.4 TRANSMITTALS

- A. Each submittal document shall have a separate cover or transmittal. Transmittals shall include the following identification data, as applicable:
 - 1. Submittal numbers shall have three parts including:
 - a. The specification section number, example 33 11 16
 - b. A sequential number identifying the number of submittals for this section, example 01
 - c. A sequential letter identifying the revision number starting with the letter A for the first submittal and progressing through the alphabet for each revised submittal, example A.
 - d. The full submittal number from the examples above is 33 11 16 01 A.
 - 2. Contract number
 - 3. Project name and location
 - 4. Product identification
 - 5. Applicable contract drawing number, specification section, and paragraph number

6. Stamp Space: Blank space of approximately 2-1/2 inches high by 4 inches wide adjacent to the identification data to receive Engineer's status stamp.
7. Contractor's certification statement as described below:
 - a. "Certification Statement: By this submittal, we hereby represent that we have determined and verified all field measurements, field construction criteria, materials, dimensions, catalog numbers and pertinent data and we have checked and coordinated each item with other applicable approved drawings and all Contract requirements."

1.5 *DEVIATIONS*

- A. Immediately following the transmittal sheet the Contractor shall include an itemized list of any deviations from the requirements in the Contract Documents.
 1. In the case of Shop Drawings a specific notation shall be made on each Shop Drawing submitted to Engineer indicating where the listed deviation applies.

1.6 *LIMITATIONS OF ENGINEER'S REVIEW*

- A. Engineer's review is only for the purposes of determining if the items covered by the submittals will conform to the requirements in the Contract Documents.
- B. Engineer's review will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.
- C. Engineer's review of a separate item will not indicate approval of the assembly in which the item functions.
- D. Engineer's review of a Submittal shall not relieve Contractor from responsibility for any deviation from the requirements of the Contract Documents unless Contractor has given Engineer specific written notice of any deviation per the requirements of this Section. Engineer will document any such accepted variation from the requirements of the Contract Documents in a Field Order.
- E. Engineer's review of a Submittal, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.

1.7 *SUBMITTAL PROCESS*

- A. Submittals shall be sent to the Engineer electronically through email or a file transfer system agreed upon by the Owner, Engineer, and Contractor during the Preconstruction Conference.
- B. Engineer will provide timely review of Submittals in accordance with the Schedule of Submittals agreed upon by the Owner, Engineer, and Contractor during the Preconstruction Conference.
- C. Submittals will be returned, marked with one of the following classifications:

SUBMITTAL PROCEDURES
01 33 00-3

1. NO EXCEPTION TAKEN: Requires no corrections, no marks.
2. MAKE CORRECTIONS NOTED: Requires minor corrections. Items may be fabricated as marked without further resubmission. Resubmit a corrected copy to the Engineer.
3. REVISE AND RESUBMIT: Requires corrections. Resubmit entire submittal following original submission with corrections noted. Allow time for checking and Engineer's appropriate action.
4. REJECTED: Submitted information does not comply with the Contract Documents. No items shall be fabricated. Resubmit entire submittal following original submission with corrections noted.
5. INFORMATION ONLY: Items in the submittal are saved in the project file for information only but were not reviewed by the Engineer.

PART 2 SUBMITTAL DOCUMENTS

2.1 SHOP DRAWINGS

- A. When requested submit, submit two (2) sets of shop drawings.

2.2 SAMPLES

- A. When requested or required by an individual specification sections, submit one (1) sample of each item.
- B. Samples shall be representative of the actual material proposed for use in the project and of sufficient size to demonstrate design, color, texture, and finish.
- C. Permanently attach to each sample:
 1. The submittal number.
 2. The contract number.
 3. Project name and location.
 4. Product identification.
 5. Applicable contract drawing and specification section number.
 6. Subcontractor's, vendor's and/or manufacturer's name, address, and telephone number.
- D. Certain samples may be tested for specific requirements by the Owner and/or Engineer prior to approval. Failure of sample to pass tests will be sufficient cause for refusal to consider further samples of the same brand and make.

- E. Rejected samples will be returned upon request, and resubmittals shall consist of new samples.

2.3 *RECORD DRAWINGS*

- A. Maintain 1 record copy of Contract Documents at the site in good order and annotated to show revisions made during construction. Keep annotations current for possible inspection.
 - 1. Make record drawings available to Engineer at all times during life of Contract.
 - 2. Drawings: Made part of record drawings and to include:
 - a. Contract Drawings: Annotate or redraft, as required, to show revisions, substitutions, variations, omissions, and discrepancies made or discovered during construction concerning location and depth of utilities, piping, ductbanks, conduits, manholes, pumps, valves, vaults, and other equipment. Make revisions and show on all drawing views with actual dimensions established to permanent points.
 - b. Working/Layout Drawings: When required as submittals, record actual layouts of conduit runs between various items of electrical equipment for power, control, and instrumentation; wire sizes, numbers, and functions; configuration of conduits; piping layouts; and duct layouts. Add sections
 - 3. Before preliminary inspection, furnish reproducible of record drawings. At completion of Contract and before final payment is made, furnish Engineer 1 set of reproducibles of finally approved record drawings reflecting revisions herein described.

2.4 *OPERATION AND MAINTENANCE MANUALS*

- A. Furnish Operation and Maintenance Manuals for various types of equipment and systems, as required by Contract Documents. Operation and Maintenance Manuals shall be provided for all mechanical and electrical equipment. Unless otherwise indicated, furnish separate manual for each piece of equipment and system. If manual contains other items or equipment, indicate where specified items are located in manual. Include in manual complete information necessary to operate, maintain, and repair specific equipment and system furnished under this Contract, and include the following specific requirements;
 - 1. Contents.
 - a. Table of Contents and Index.
 - b. Brief description of equipment/system and principal components.
 - c. Starting and stopping procedures, both normal and emergency.
 - d. Installation, maintenance, and overhaul instructions including detailed assembly drawings with parts list and numbers, and recommended

SUBMITTAL PROCEDURES
01 33 00-5

spare parts list with recommended quantity, manufacturer's price, supplier's address, and telephone number.

- e. Recommended schedule for servicing, including technical data sheets that indicate weights and types of oil, grease, or other lubricants recommended for use and their application procedures.
- f. One copy of each component wiring diagram and system wiring diagram showing wire size and identification.
- g. One approved copy of each submittal with changes made during construction properly noted, including test certificates, characteristic curves, factory and field test results.
- h. For electrical systems, include dimensioned installation drawings, single line diagrams, control diagrams, wiring and connection diagrams, list of material for contactors, relays and controls, outline drawings showing relays, meters, controls and indication equipment mounted on equipment or inside cubicles, control and protective schematics, and recommended relay settings.

2. Material:

- a. Preliminary
 - 1) Submit one (1) electronic copy of the preliminary O&M manuals in searchable PDF format.
- b. Final
 - 1) Submit one (1) electronic copy of the final O&M manuals in searchable PDF format.
 - 2) Submit two (2) hard copies of the final O&M Manual as described below:
 - a) Covers: Oil, moisture, and wear resistant 9 inches by 11-1/2 inches size.
 - b) Pages: 60 pound paper 8-1/2 inches by 11 inches size with minimum of 2 punched holes 8-1/2 inches apart reinforced with plastic, cloth, or metal.
 - c) Fasteners: Metal screw post or Acco metal strap type.
 - d) Diagrams and Illustrations: Attach foldouts, as required.

PART 3 EXECUTION

NOT USED

END OF SECTION

SUBMITTAL PROCEDURES
01 33 00-6

SECTION 01 35 00

MATERIAL SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.1 GENERAL

- A. The materials furnished and used shall be new, except as may be provided elsewhere in these Specifications, or on the Plans.
- B. All materials required to complete the work under this contract shall be furnished by the Contractor, unless otherwise stated.
- C. It shall be the duty of the Contractor to call the Engineer's attention to apparent errors or omissions and request instruction before proceeding with the Work. The Engineer may, by appropriate instructions, correct said apparent errors and omissions, which instructions shall be as binding upon the Contractor as though contained in the original Contract Documents.

1.2 RELATED WORK

- A. Section 01 33 00 – Submittal Procedures

1.3 DEFINITIONS

- A. Substitutions: Requests for changes in products, materials, equipment, and methods of construction required by Contract Documents proposed by the Contractor.
- B. Revisions: Changes to Contract Documents requested by Owner or Engineer.
- C. Options: Specified options of products and construction methods included in Contract Documents.

1.4 TRADE NAMES AND ALTERNATIVES

- A. Wherever an article, or any class of materials, is specified by the trade name or by the name of any particular patentee, manufacturer or dealer, or by reference to the catalog of any such manufacturer or dealer, it shall be taken as intending to mean and specify the article or material described or any other equal thereto in quality, finish and durability, and equally as serviceable for the purpose for which it is or they are intended. The intent of the Plans and Specifications is to specify highest grade standard equipment, and it is not the intent of these Plans and Specifications to exclude or omit the products of any responsible manufacturer, if such products are equal in every practical respect to those mentioned herein, as determined by the Engineer.

1.5 SAMPLES

- A. At the option of the Engineer, the source of supply of materials for the Work shall be subject to tests and inspection before the delivery is started and before such materials are used in the Work. Samples representative of the character and quality of materials shall be submitted by the Contractor. Samples shall be of sufficient quantities or amounts for testing or examination.
- B. All tests of materials furnished by the Contractor shall be made in accordance with the commonly recognized standards of national technical organizations, and such special methods and tests as are prescribed in the Contract Documents.
- C. The Contractor shall furnish such samples of materials as are requested by the Engineer, without charge. No material shall be used until the Engineer has had the opportunity to test or examine such materials. Samples will be secured and tested whenever necessary to determine the quality of the material. Samples and test specimens prepared at the jobsite, such as concrete test cylinders, shall be taken or prepared by the Engineer, or his designated representative, in the presence and with the assistance of the Contractor.

1.6 SUBMITTALS

- A. Material Submittals shall be made in accordance with Section 01 33 00.

1.7 INSPECTION OF MATERIALS BY THE CONTRACTOR

- A. Contractor shall make a close inspection of all materials as delivered, and shall promptly return all defective materials without waiting for their rejection by the Engineer.

1.8 CERTIFICATES OF COMPLIANCE

- A. A Certificate of Compliance may be required for certain materials and equipment that become final products of the completed Work. Certificates of Compliance shall be furnished prior to the use of any materials for which these Specifications require that such a certificate be furnished. In addition, when so authorized in these Specifications, the Engineer may permit the use of certain materials or assemblies prior to sampling and testing if accompanied by a Certificate of Compliance.
- B. The Certificate shall be signed by the manufacturer of the material or the manufacturer of assembled materials and shall state that the materials involved comply in all respects with the requirements of the Specifications.
- C. A Certificate of Compliance shall be furnished with each lot of material delivered to the Work and the lot so certified shall be clearly identified in the certificate.
- D. All materials used on the basis of a Certificate of Compliance may be sampled and tested at any time. The fact that material is used on the basis of a Certificate of Compliance shall not relieve the Contractor of responsibility for incorporating material in the Work which conforms to the requirements of the Plans and

Specifications and any such material not conforming to such requirements will be subject to rejection whether in place or not.

- E. The City of Tulare reserves the right to refuse to permit the use of material on the basis of a Certificate of Compliance.
 - 1. The form of the Certificate of Compliance and its disposition shall be as directed by the Engineer.

1.9 MANUFACTURER TESTING

- A. At the option of the Engineer, materials and equipment to be supplied under this Contract will be tested and inspected either at their place of origin or at the site of the Work. The Contractor shall give the Engineer written notification well in advance of actual readiness of materials and equipment to be tested and inspected at point of origin.
 - 1. Satisfactory tests and inspections at the point of origin shall not be construed as a final acceptance of the materials and equipment nor shall such tests and inspections preclude retesting or re-inspection at the site of the Work.
 - 2. Materials and equipment which will require testing and inspection at the place of origin shall not be shipped prior to such testing and inspection.

1.10 MANUFACTURERS' RECOMMENDATIONS

- A. All equipment specified and used in the project shall be installed in accordance with the approved manufacturer's current written recommendations.
- B. All such equipment, material, etc., shall be of the manufacturer's latest system or line.

1.11 SUBSTITUTIONS

- A. Conditions: Contractor's substitutions shall be considered when one or more conditions are satisfied, as determined by the Engineer. (The Contractor's submittal and Engineer's acceptance of Shop Drawings, Product Data or Samples that relate to construction activities not complying with the Contract Documents does not constitute an acceptable or valid request for substitution, nor does it constitute approval.)
 - 1. Extensive revisions to Contract Documents are not required.
 - 2. Proposed changes are in keeping with the general intent of the Contract Documents.
 - 3. Request is timely, fully documented and properly submitted.
 - 4. Request is directly related to an "or equal" clause or similar language in the Contract Documents.

5. The specified product or method of construction cannot be provided within the Contract Time. The request shall not be considered if the product or method cannot be provided as a result of failure to pursue the Work promptly or coordinate activities properly.
6. The specified product or method of construction cannot receive necessary approval by governing authority, and the requested substitution can.
7. Substantial advantage is offered the Owner, in terms of cost, time, energy conservation or other considerations of merit, after deducting offsetting responsibilities the Owner may be required to bear.
 - a. Additional responsibilities for the Owner may include additional compensation to the Engineer for redesign and evaluation services, increased cost of other construction by the Owner or separate Contractors, and similar considerations.
 - b. Contractor shall provide all data in support of any proposed substitute or "or-equal" at Contractor's expense.
8. Specified product or method of construction cannot be provided in a manner that is compatible with other materials, and where the Contractor certifies that the substitution will overcome the incompatibility.
9. Specified product or method of construction cannot be coordinated with other materials, and where the Contractor certifies that the proposed substitution can be coordinated.
10. Specified product or method of construction cannot provide a warranty required by the Contract Documents and where the Contractor certifies that the proposed substitution provide the required warranty.

1.12 SUBSTITUTION REQUEST FORM

- A. Use Substitution Request Form included at the end of this Section.
- B. Submit one form for each request.

END OF SECTION

SUBSTITUTION REQUEST FORM

Page 1 of 2

TO: _____

PROJECT: _____

We hereby submit for your consideration the following product instead of the specified item for the above project:

SECTION:	PARAGRAPH:	SPECIFIED ITEM:
_____	_____	_____

Proposed Substitution: _____

Attach: 1) Complete technical data, including laboratory tests, if applicable.

2) Complete information on changes to Drawings and/or Specifications which proposed substitution will require for its proper installation.

A. Does the substitution affect dimensions on Drawings?

B. Will the undersigned pay for changes to the project design, including engineering and detailing costs caused by the requested substitution?

C. What affect does substitution have on other trades?

D. Differences between proposed substitution and specified item?

E. Manufacturer's guarantees of the proposed and specified items are:

____ Same _____ Different (explain on attached sheet)

MATERIAL SUBSTITUTION PROCEDURES
01 35 00-5

SUBSTITUTION REQUEST FORM

Page 2 of 2

The undersigned states that the function, appearance, and quality are equivalent or superior to the specified item.

Submitted By:

Signature _____

Firm _____

Address _____

Date _____

Telephone _____

For Use by Design Consultant
No Exceptions Taken
Make Corrections Noted
Rejected
Received Late
By _____

Date _____
Remarks _____

MATERIAL SUBSTITUTION PROCEDURES
01 35 00-6

SECTION 01 42 13

DEFINITIONS AND ABBREVIATIONS

PART 1 GENERAL

1.1 DEFINITIONS AND TERMS

- A. Whenever in these Specifications, or in other Contract Documents, the following terms are used, the intent and meaning shall be interpreted as follows:
1. Board: State Water Resources Control Board
 2. Calendar Day: Every day shown on the calendar.
 3. Contractor: The word "Contractor" means the person, firm or corporation to whom the award is made. Subcontractors as such will not be recognized.
 4. Contract Unit Price: The Contractor's original bid for a single unit of an item of work in the Proposal.
 5. Contract Time: The number of calendar days for completion of the Work, including authorized time extensions. In the event a calendar date is specified for Project completion in lieu of a number of calendar days, the Work shall be completed by that calendar date. The Contract Time shall be computed by excluding the first and including the last day; and if the last day be Sunday or a legal holiday, that shall be excluded.
 6. Engineer: Provost & Pritchard Consulting Group, 286 West Cromwell, Fresno, California 93711-6162, (559) 449-2700.
 7. Equipment: (Construction) - All machinery and equipment, together with the necessary supplies for upkeep and maintenance, and also tools and apparatus necessary for the proper construction and acceptable completion of work. (Installed) - All material or articles used in equipping a facility as furnishings or apparatus to fulfill a functional design.
 8. General Conditions: General and Special Provisions of the City of Tulare.
 9. General Requirements: All specifications contained in Division 1.
 10. Notice: Any notice allowed or required to be given by the Owner may be given by the Engineer.
 11. Owner: City of Tulare.
 12. Person: Any individual, association, partnership, corporation, trust, joint venture or other legal entity.

13. Plans: The drawings, profiles, cross-sections, working drawings and supplemental drawings, or reproduction thereof, approved by the Engineer, which show the location, character, dimensions or details of the work.
14. Proposal: The offer of a Bidder when submitted on the Proposal form; properly signed and guaranteed.
15. Reference Documents: Bulletins, Rules, Methods of Analysis or Test, Codes, Standards, and Specifications of public or private agencies, Engineer Societies, or Industrial Associations. Reference shall be to the latest edition thereof, including Amendments, which are in effect and published at the time the Request for Bids is issued, unless a specific edition is identified, in which case reference shall be to such specific edition. Reference Documents are intended to amplify the descriptions of materials, equipment, and construction systems and are to be considered a part of the Contract Documents insofar as the various sections thereof are referred to hereinafter. Examples of Reference Documents are Federal Specifications, State Standard Specifications, and those of American Society of Testing Materials (ASTM), American National Standards Institute (ANSI), American Standards Associations (ASA), and American Concrete Institute (ACI).
16. Salvage: The protection storage, and/or removal of specified existing equipment, parts or materials during the work for retention and later use by the Owner.
17. Sanitary Sewer: Any conduit and appurtenances intended for the reception and transfer of sewage.
18. State: The State of California.
19. State Standard Plans: State of California, Business and Transportation Agency, Department of Transportation, Caltrans, Standard Plans, latest revision.
20. State Standard Specifications: Standard Specifications for the project are those entitled "Standard Specifications, State of California, Business and Transportation Agency, Department of Transportation", current version, hereinafter referred to as the State Standard Specifications. These Specifications are to be considered a part of the Contract Documents insofar as they are not superseded by other provisions contained in Divisions 0 through 48 of these Specifications.
21. Storm Sewer: Any conduit and appurtenances intended for the reception and transfer of storm water.
22. Street: Any public road, highway, parkway, freeway, alley, walk or right-of-way.
23. Surety: Any individual, firm or corporation bound with and for the Contractor for the acceptable performance, execution and completion of the Work, and for the satisfaction of all obligations incurred.

24. Utility: Tracks, overhead or underground wires, pipelines, conduits, ducts or structures, sewers or storm drains owned, operated or maintained in or across a public right-of-way or private easement.
25. Water Main: Any conduit and appurtenances intended for the distribution of water.
26. Working Day: Any weekday (Monday through Friday), not a designated national holiday, during which weather allows the Contractor to work four or more hours consecutively, starting no later than 10:00 AM.

1.2 REFERENCED STANDARDS

- A. The standards referred to, except as modified, shall have full force and effect as though printed in this Specification, and shall be the latest edition or revision thereof in effect on the bid opening date, unless a particular edition or issue is indicated. Copies of these standards are not available from the Owner. The Engineer will furnish, upon request, information as to how copies may be obtained.

1.3 LIST OF ABBREVIATIONS

- A. Abbreviations and terms, or pronouns in place of them, shall be interpreted as follows:

AA	Aluminum Association
AABC	Associated Air Balance Council
AAMA	Architectural Aluminum Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
ABMA	American Boiler Manufacturers Association
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
ADC	Air Diffusion Council
AEIC	Association of Edison Illuminating Companies
AFBMA	Antifriction Bearing Manufacturers Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AHA	American Hardboard Association
AI	Asphalt Institute
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Moving and Conditioning Association
ANSI	American National Standards Institute
APA	American Plywood Association
API	American Petroleum Institute
APWA	American Public Works Association
ARI	American Refrigeration Institute
ASA	(now U.S.A.S.I., USA Standards Institute) Association & its Standard Specifications
ASAHC	American Society of Architectural Hardware Consultants
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers

DEFINITIONS AND ABBREVIATIONS

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City of Tulare
Industrial WWTP Dewatering Project

ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials
AWG	American Wire Gage
AWI	Architectural Woodwork Institute
AWPA	American Wood-Preservers' Association
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Institute of America (formerly SCPI)
CAL/OSHA	California Occupational Safety and Health Administration
CALTRANS	California Department of Transportation
CBC	California Building Code
CCR	California Codes of Regulations
CDA	Copper Development Association
CEC	California Electrical Code
CEQA	California Environmental Quality Act
CFR	Code of Federal Regulations
CISPI	Cast Iron Soil Pipe Institute
CMAA	Crane Manufacturers Association of America
CMC	California Mechanical Code
CPC	California Plumbing Code
CRA	California Redwood Association
CRSI	Concrete Reinforcing Steel Institute
CS	Commercial Standard (U.S. Department of Commerce)
DDW	State Water Resources Control Board, Division of Drinking Water
DHI	Door and Hardware Institute
DIPRA	Ductile Iron Pipe Research Association
EEI	Edison Electric Institute
EJCDC	Engineers' Joint Contract Documents Committee
EPA	Environmental Protection Agency
FED SPEC	Federal Specification
FCI	Fluid Controls Institute
FGMA	Flat Glass Marketing Association
FIA	Factory Insurance Association
FM	Factory Mutual
FSA	Fluid Sealing Association
FTI	Facing Tile Institute
GAC	Granular Activated Carbon
HEI	Heat Exchange Institute
HMI	Hoist Manufacturers Institute
HPMA	Hardwood Plywood Manufacturers Association
HTI	Hand Tools Institute
ICBO	International Conference of Building Officials
I-B-R	Institute of Boiler and Radiator Manufacturers
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineering Society
IFI	Industrial Fasteners Institute
IPCEA	Insulated Power Cable Engineers Association

DEFINITIONS AND ABBREVIATIONS
01 42 13-4

City of Tulare
Industrial WWTP Dewatering Project

ISA	Instrument Society of America
JIC	Joint International Conference (Hydraulic Institute)
MHI	Materials Handling Institute
MIL	Military Specification
MMA	Monorail Manufacturers Association
MSS	Manufacturers' Standardization Society
NAAMM	National Association of Architectural Metals Manufacturers
NACE	National Association of Corrosion Engineers.
MBBPVI	National Board of Boiler and Pressure Vessel Inspectors
NBHA	National Builders Hardware Association
NCSPA	National Corrugated Steel Pipe Association
NEC	National Electrical Code
NECA	National Electrical Contractors Association
NEMA	National Electrical Manufacturers Association
NEMI	National Elevator Manufacturing Industry
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
NLA	National Lime Association
NPC	National Plumbing Code
NPT	National Pipe Thread
NRCA	National Roofing Contractors' Association
NRMCA	National Ready Mixed Concrete Association
NSC	National Safety Council
NSF	National Sanitation Foundation
NTMA	National Terrazzo and Mosaic Association
NWMA	National Woodwork Manufacturers Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
PDI	Plumbing and Drainage Institute
PFI	Pipe Fabrication Institute
PS	Product Standard
RTI	Resilient Tile Institute (formerly AVATI)
SAE	Society of Automotive Engineers
SCPRF	Structural Clay Products Research Foundation
SI	International Systems of Units (Metric)
SIGMA	Sealed Insulating Glass Manufacturers Association
SFPA	Southern Forest Products Association
SJI	Steel Joist Institute
SMA	Screen Manufacturers Association
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SPFA	Steel Plate Fabricators Association
SPI	Society of the Plastics Industry
SPTA	Southern Pressure Treaters Association
SSI	Scaffolding and Shoring Institute
SSPC	Steel Structures Painting Council
SSPWC	Standard Specifications for Public Works Construction (Greenbook)

City of Tulare
Industrial WWTP Dewatering Project

UL	Underwriters' Laboratories
UPC	Uniform Plumbing Code
USBR	U.S. Bureau of Reclamation
USGS	United States Geological Survey
WCLA	West Coast Lumbermen's Association (Std. Grading and Dressing Rule)
WCLIB	West Coast Lumber Inspection Bureau
WIC	Woodwork Institute of California
WRI	Wire Reinforcement Institute, Inc.
WWPA	Western Wood Products Association
WWTP	Wastewater Treatment Plant

END OF SECTION

SECTION 01 43 00
QUALITY CONTROL AND TESTING

PART 1 GENERAL

1.1 NOTICE OF DEFECTS

- A. Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.
- B. All defective Work may be rejected, corrected, or accepted, at the discretion of the Owner and Engineer.

1.2 RELATED WORK

- A. Section 01 35 00 – Materials and Substitutions

1.3 ACCESS TO WORK

- A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and governmental agencies with jurisdictional interests shall have access to the Site and the Work at reasonable times for their observation, inspecting, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's Site safety procedures and programs so that they may comply therewith.

1.4 MATERIALS AND EQUIPMENT

- A. Materials and equipment shall be subject to the requirements of Section 01 35 00.

1.5 PROJECT SITE TESTING

- A. Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.
- B. Except for specified material suitability tests, all initial routine tests of materials shall be at the expense of the Owner and shall be performed by an independent certified laboratory designated by the Owner. Whenever a specified percent relative compaction test is required and the material or portion thereof so tested fails to meet or exceed the relative compaction specified, all subsequent retesting shall be performed at the expense of the Contractor.
- C. All material suitability tests shall be at the expense of the Contractor. Testing shall be by an independent certified laboratory approved by the Engineer.

1.6 TEST STANDARDS

- A. All sampling, specimen preparation, and testing of materials shall be in accordance with the standards of nationally recognized technical organizations.

QUALITY CONTROL AND TESTING
01 43 00-1

- B. The physical characteristics of all materials not particularly specified shall conform to the latest standards published by the ASTM, where applicable.

1.7 UNCOVERING WORK

- A. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without concurrence of Engineer, it must, if requested by Engineer, be uncovered for Engineer's observation and recovered at Contractor's expense.
- B. If Engineer considers it necessary or advisable that covered Work be re-observed by Engineer or inspected or tested by others, Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment.
 - 1. If it is found that the uncovered Work is defective, Contractor shall promptly correct said defects, including all work involved in uncovering and recovering the work, at no cost to the Owner.
 - 2. If, the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction.

1.8 CORRECTION OR REMOVAL OF DEFECTIVE OR REJECTED WORK

- A. Upon receipt of notice, Contractor shall correct all defective or rejected Work and replace it with Work that is not defective, at no cost to the Owner.

1.9 ACCEPTANCE OF DEFECTIVE WORK

- A. If, instead of requiring correction or removal and replacement of defective Work, Owner prefers to accept it, Owner may do so.
 - 1. If any such acceptance occurs, a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work, and Owner shall be entitled to an appropriate decrease in the Contract Price, reflecting the diminished value of Work so accepted.
 - 2. Engineer shall determine the reasonableness of the diminished value of Work so accepted and Contractor shall pay all costs involved in making such determination.

END OF SECTION

SECTION 01 50 00

TEMPORARY FACILITIES

PART 1 GENERAL

1.1 GENERAL

- A. The Contractor shall provide all temporary facilities and utilities required for completion of the Work as well as safety precautions and programs. No attempt is made to set out in detail the Contractor's means or methods necessary to accomplish the tasks involved.

1.2 RELATED WORK

- A. Section 01 14 00 – Work Restrictions
- B. Section 01 33 00 – Submittal Procedures
- C. Section 11 00 00 – General Equipment Stipulations

1.3 TEMPORARY UTILITIES

- A. Water
 - 1. Contractor may make arrangements with the Owner to use municipal water where appropriate during construction.
 - 2. The Contractor shall pay for and construct facilities necessary to furnish potable water for human consumption and water to be used during construction.
 - 3. Water used for human consumption shall be kept free from contamination and shall conform to the requirements of the State and local authorities for potable water.
 - 4. Remove all temporary facilities constructed to furnish water prior to completion of the Work.
 - 5. If non-potable water is used during construction Contractor shall post signs stating that the water is non-potable and not for drinking.
- B. Sanitary Facilities
 - 1. The Contractor shall provide suitable and adequate sanitary conveniences for the use his staff at the site of the Work. Such conveniences shall include chemical toilets or water closets and shall be located at appropriate locations at the site of the Work. All sanitary conveniences shall conform to the regulations of the public authority having jurisdiction over such matters. At the completion of the Work, all such sanitary conveniences shall be removed and the site left in a sanitary condition.

TEMPORARY FACILITIES
01 50 00-1

2. With respect to sanitation facilities, the Contractor shall cooperate with and follow directions of representatives of the Public Health Service and the State. State and County Public Health Service representatives shall have access to the Work, whether it is in preparation or progress, and the Contractor shall provide facilities for such access and inspection.

1.4 TEMPORARY CONSTRUCTION FACILITIES

- A. Construction hoists, shoring, and similar temporary facilities shall be of ample size and capacity to adequately support and move the loads to which they will be subjected. Railings, enclosures, safety devices, and controls required by law or for adequate protection of life and property shall be provided.
- B. Temporary supports shall be designed with an adequate safety factor to assure adequate load bearing capability. The Contractor shall submit design calculations prepared by a professional registered engineer for staging and shoring prior to application of loads.
- C. Barriers shall be placed at each end of all excavations and at such places as may be necessary along excavations to warn all pedestrian and vehicular traffic of such excavations from one hour before sunset each day to one hour after sunrise of the next day until such excavation is entirely refilled, compacted, and paved. All excavations shall be barricaded in such a manner as to prevent person from falling, walking, or otherwise entering any excavation in any street, roadway, parking lot, treatment plant, or any other area, public or private.
- D. The Contractor shall adequately identify and guard all hazardous areas and conditions by visual warning devices and, where necessary, physical barriers. Such devices shall, as a minimum, conform to the requirements of Cal/OSHA.
- E. At such time or times any temporary construction facilities and utilities are no longer required for the work, the Contractor shall notify the Engineer of his intent and schedule for removal of the temporary facilities and utilities, and obtain the Engineer's approval before removing the same. As approved, the Contractor shall remove the temporary facilities and utilities from the site as his property and leave the site in such condition as specified, as directed by the Engineer, and/or as indicated on the Plans.
- F. Temporary piping shall be coordinated with the Owner so as not to impede operation of the facility.

1.5 ACCESS ROADS AND STAGING AREA

- A. Adequate access shall be maintained to all storage areas and other areas to which frequent access is required. The Contractor shall limit the location of his storage of equipment and materials outside of the project site. The Contractor shall make his own arrangements for space that may be required and bear all associated costs. The Contractor shall provide any temporary storage required for the protection of equipment and materials as recommended by manufacturers of such materials.
- B. Storage and protection:

TEMPORARY FACILITIES
01 50 00-2

1. Materials and equipment shall be stored in accordance with supplier's written instructions, with seals and labels intact and legible. Exposed metal surfaces of valves, fittings and similar materials shall be coated with accordance with manufacturer's recommendations to prevent corrosion.
2. Storage shall be arranged to provide access for inspection. The Contractor shall periodically inspect to assure materials and equipment are undamaged and are maintained under required conditions.

END OF SECTION

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SECTION 01 57 50
CONSTRUCTION STAKES, LINES, AND GRADES

PART 1 GENERAL

1.1 LINES AND GRADE

- A. The Work shall be executed in accordance with the lines and grades indicated in the Contract Documents. Distances and measurements, except elevations and structural dimensions, shall be made on horizontal planes.

1.2 OWNER'S SURVEY SERVICES

- A. Construction surveying and staking for construction will be done by a third party hired by the Owner. The construction staking will provide one set of grade control stakes.
- B. Additional detail staking layout will be the responsibility of the Contractor.
- C. The Contractor shall be responsible for preserving construction survey stakes, permanent survey monuments and bench marks for the duration of their usefulness. If any construction survey stakes permanent survey monuments or benchmarks are lost or disturbed and need to be replaced, such replacement shall be made by the Engineer at the expense of the Contractor.
- D. The Contractor shall notify the Owner at least three (3) working days before he will require survey services in connection with laying out of any portion of the Work. The Contractor at his own expense shall dig all holes necessary for line and grade stakes prior to requesting survey services that depend on such digging.

END OF SECTION

CONSTRUCTION STAKES, LINES, AND GRADES
01 57 50-1

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SECTION 01 64 00
OWNER FURNISHED PRODUCTS

PART 1 GENERAL

1.1 GENERAL

- A. The section describes equipment furnished by the Owner.

1.2 RELATED WORK

- A. Section 46 76 00 – Residuals Dewatering Equipment

1.3 OWNER FURNISHED EQUIPMENT

- A. Residuals Dewatering Equipment
1. The City procured the Residuals Dewatering Equipment for the project as shown in the drawings and as appended to Section 46 76 00.
 2. The Residuals Dewatering Equipment has already been fabricated and are ready to be shipped when the Contractor is ready.
 3. The Residuals Dewatering Equipment shall be shipped directly to the WWTP site.
 4. The Contractor shall coordinate with the Supplier to confirm the delivery schedule for the equipment and be ready to install the equipment when it arrives.
 5. The Contractor shall have the site ready for installation by December 2020.
 6. Installation and startup shall be completed per the requirements in Section 46 76 00.

PART 2 MATERIALS

NOT USED.

PART 3 EXECUTION

NOT USED.

END OF SECTION

OWNER FURNISHED PRODUCTS
01 64 00-1

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SECTION 01 70 00
CONTRACT CLOSEOUT

PART 1 GENERAL

1.1 GENERAL

- A. It is the intent of these Contract Documents that the Contractor shall deliver a complete and operable facility capable of performing its intended functions and ready for use.

1.2 RELATED WORK

- A. Section 01 33 00 – Submittal Procedures

1.3 CLEANING

- A. Throughout the period of construction the Contractor shall keep the Work site free and clean of all rubbish and debris, and shall promptly remove from the site, or from property adjacent to the site of the Work, all unused and rejected materials, surplus earth, concrete, plaster, and debris, excepting select material which may be required for refilling or grading.

1.4 FINAL SITE CLEAN-UP

- A. Upon completion of the Work, and prior to final acceptance, the Contractor shall remove from the vicinity of the Work all paint, surplus material, and equipment belonging to him or used under his direction during construction.
- B. The Contractor shall restore to original condition all property not designated for alteration by these Contract Documents.

1.5 FINAL BUILDING CLEAN-UP

- A. On all building projects and wherever else applicable, besides general broom cleaning, the following special cleaning shall be performed at completion of the Work:
 - 1. Putty stains and paint shall be removed from glass; glass shall be washed and polished, inside and outside. Care shall be exercised so as not to scratch glass.
 - 2. Marks, stains, fingerprints, and other soil and dirt shall be removed from painted, decorated, or stained work.
 - 3. Waxed woodwork shall be cleaned and polished.
 - 4. Hardware shall be cleaned and polished of all traces; this shall include removal of stains, dust, dirt, paints, and blemishes.

CONTRACT CLOSEOUT
01 70 00-1

5. Spots, soil, paint, plaster, and concrete shall be removed from tile; tile work shall be washed afterwards.
6. Fixtures and equipment shall be cleaned and stains, paint, dirt, and dust shall be removed.
7. Temporary floor protection shall be removed; floors shall be cleaned, waxed, and buffed.
8. Dust, cobwebs, and traces of insects and dirt shall be removed.

1.6 WASTE DISPOSAL

- A. The Contractor shall dispose of surplus materials, waste products, demolition materials, and debris. The Contractor shall transport and dispose of waste materials in accordance with applicable laws and regulations.

1.7 PROJECT RECORD DOCUMENTS

- A. The Contractor shall maintain at the site, available to the Owner and Engineer, one copy of the Contract Documents, Drawings, Shop Drawings, Change Orders, and other modifications in good order and annotated to show all changes made during construction. These Documents shall be delivered to the Engineer for the Owner upon completion of the Work.
- B. Record documents shall be reviewed during progress meetings to ascertain that all changes have been recorded.
- C. Store Record Documents separate from documents used for construction.

1.8 TOUCH-UP AND REPAIR

- A. The Contractor shall touch-up or repair finished surfaces on structures, equipment, fixtures, or installations that have been damaged prior to final acceptance. Surfaces on which such touch-up or repair cannot be successfully accomplished shall be completely refinished or in the case of hardware and similar small items, the item shall be replaced. Such items shall include, but not be limited to, the following:
 1. Road surfaces
 2. Exposed structure surfaces
 3. Exposed equipment surfaces
 4. Exposed piping surfaces

1.9 EQUIPMENT START-UP

- A. After all acceptance tests have been completed by the Contractor and Owner but prior to final acceptance, the Contractor shall recheck all equipment for proper alignment and adjustment, check oil levels, re-lubricate all bearings and wearing

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points, and in general assure that all equipment is in proper condition for continuous operation.

1.10 OPERATION AND MAINTENANCE (O&M) MANUALS

- A. See Section 01 33 00.

1.11 FINAL EQUIPMENT CHECK

- A. After testing and before acceptance, all equipment shall be test run by the Owner for a minimum of 7 days to ensure proper operation. At the end of the test run each piece of machinery shall be lubricated and all components and couplings checked for proper alignment and adjustment.
- B. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Engineer's inspection.
- C. Provide submittals to the Owner required by other governing authorities.

1.12 MANUFACTURER'S CERTIFICATES OF PROPER INSTALLATION

1. The Contractor shall submit manufacturers' certificates of proper installation for all items of equipment.

PART 2 PRODUCTS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

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SECTION 02 41 00

DEMOLITION

PART 1 GENERAL

1.1 DESCRIPTION

- A. The work of this section includes the following:
 - 1. Repair and restoration of areas damaged due to demolition work.
 - 2. Salvaging of equipment for Owner.
 - 3. Removal of demolished materials from site.
 - 4. Remove existing piping and other existing structures as shown on the Plans to be removed.
 - 5. Properly dispose of all removed materials.
 - 6. Dewatering as needed in order to complete the proposed demolition.
 - 7. Removal of trees and landscaping as required for construction.

1.2 RELATED WORK

- A. Section 01 14 00 – Work Restrictions
- B. Section 01 70 00 – Contract Closeout
- C. Section 03 30 01 – Cast In Place Concrete
- D. Section 31 11 00 – Clearing and Grubbing
- E. Section 31 23 00 – Earthwork.
- F. Section 32 11 23 – Aggregate Base

1.3 DEFINITIONS:

- A. Portland Cement Concrete: A mixture of Portland cement, fine aggregate, coarse aggregate, admixtures (if used) and water, proportioned and mixed. Also, included is rebar.
- B. Asphalt Concrete: A mixture of liquid asphalt and graded aggregate used as paving material for roadways and parking lots.

1.4 SEQUENCING

- A. Sequence work to minimize interference with the existing facilities. See Section 01 14 00.

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1.5 REGULATORY REQUIREMENTS

- A. Dispose of removed materials in an approved disposal or salvage facility.

1.6 REFERENCES

- A. Section 17-2 – Clearing and Grubbing, State Standard Specifications
- B. Section 19 – Earthwork, State Standard Specifications

1.7 SUBMITTALS

- A. As specified in Section 01 33 00 – Submittal Procedures
- B. Demolition plan including sequence of operations. The plan shall specifically address methods of demolition, schedule, sequence of demolition, and procedures for archeological monitoring. Demolition shall not proceed until the plan has been approved.

1.8 QUALITY ASSURANCE

- A. General: Take all necessary precautions with regard to safety in carrying out the demolition and site work. Erect suitable barriers around open excavations and fulfill all appropriate requirements of CAL/OSHA. Comply with safety requirements for demolition, ANSI A10.6-90.

1.9 PROJECT CONDITIONS

- A. Underground utilities exist at this site. Contractor shall take all necessary precautions to protect said utilities. Notify Engineer of any deviation in utility location from that which is shown on the drawings.
- B. Keep dust to a minimum at removal site and on haul roads. Use sprinklers or water trucks as necessary or as directed by the Engineer.
- C. Ensure safety of persons in demolition area. Provide temporary barricades as required.
- D. Excavations may encounter groundwater and require dewatering depending on the time of year and amount of seasonal run-off. Loose sands exposed in excavation sidewalls may be unstable and require shoring or lying back in accordance with OSHA requirements. Flowing sands may also be encountered in excavations below groundwater levels.

1.10 CLOSEOUT SUBMITTALS

- A. As specified in Section 01 70 00.
- B. Show all capped and abandoned utility terminations and location of remaining facilities on project Record Drawings.

PART 2 PRODUCTS

2.1 REPAIR AND RESTORATION MATERIALS

- A. Concrete shall be as specified in Section 03 30 01.
- B. Backfill materials shall be as required by Section 19 – Earthwork, State Standard Specifications.

2.2 MATERIALS

- A. Salvaged Materials: Materials to be salvaged shall remain the property of the Owner and shall be stockpiled as directed by the Engineer. Contractor shall inventory all salvaged materials. Stockpiled materials shall be free of hazardous substances. Salvage materials include:
 - 1. Signs: All site identification, regulatory and as shown on drawings.
 - 2. Pipe and Fittings
 - 3. Valves
 - 4. Flow Meters
 - 5. Shade Structures
 - 6. Above ground furniture and fences as shown on the drawings and as directed by the Engineer.
- B. Items to be Salvaged and Relocated shall be salvaged and/or relocated as shown on the drawings, or as directed by the Engineer.
- C. Materials and items demolished and not designated for reuse, salvage or transfer to the Owner, as well as all debris, rubbish and other materials resulting from the demolition operations, shall become the property of the Contractor and shall be removed from the site within 48 hours of demolition.
- D. Storage or sale of the removed items will not be permitted at the site.

PART 3 EXECUTION

3.1 INSPECTION

- A. Prior to demolition, inspect the site conditions, verifying all governing dimensions, notes and specification. Notify the Engineer of any errors or omissions in the contract documents.
- B. Make such explorations and probes as are necessary to ascertain any required protection measures before proceeding with the demolition and removal work.

3.2 *PREPARATION*

- A. Protect existing, appurtenances, structures, which are not to be demolished.
- B. Prior to demolition work, all soil erosion control measures and inlet protection barriers shall be in place. Contractor shall provide appropriate measures to prohibit demolition debris and/or soil from entering any watercourse.
 - 1. Protect all buildings, structures, utilities, and vegetation to remain.

3.3 *DEMOLITION REQUIREMENTS*

- A. Conduct demolition to protect and minimize damage to structures and existing improvements.
- B. Conduct salvaging to protect and minimize damage to salvaged equipment.
- C. All work within a Caltrans right of way shall conform to Section 15 of the State Standard Specifications.
- D. Execute the work in a careful, orderly and safe manner, with the least possible disturbance to the public. Cease operations immediately if adjacent work appears to be endangered. Do not resume operations until corrective measures have been taken.
- E. Pavement and Slabs:
 - 1. Remove completely all Portland cement concrete slabs-on-grade including, but not limited to, equipment pads, sidewalks, etc. If approved by the Engineer, the Contractor may crush Portland concrete for use as aggregate base.
 - 2. Saw cut existing asphalt concrete pavements cleanly in straight continuous lines. Remove asphalt concrete pavement as shown on the drawings.
 - a. Asphalt Concrete Milling Equipment: Milling machines shall be power operated, self-propelled machines capable of removing the desired thickness. They shall have sufficient power, traction and stability to accurately maintain depth of cut and slope.
 - 3. Any material thus processed shall conform to the specifications for Section 32 11 23 .
 - 4. In areas that are demolished, but where no future roads or structures are shown, the exposed subgrade shall be scarified an additional 18 inches before placing backfill.
- F. Concrete and Masonry Structures: Remove structure to a minimum of 3 feet below grade. Break remaining portions to permit drainage. Remove completely if under proposed structures or roadways.

- G. Items to be Salvaged: Remove as directed by the Engineer. Remove carefully. All salvaged material remains the property of the Owner. Store where directed by the Engineer.
- H. Abandoned Utilities: Remove above ground utilities and terminate as approved by the utility company and the Engineer. Remove necessary portions of underground utilities to within 24 inches of excavation or final grade. Plug abandoned pipes and conduits with concrete plugs. Plugs shall be 6 inches or 2 times the pipe diameter in length, whichever is greater.
 - 1. Water lines shall be capped as close as possible to active mains.

3.4 *SALVAGE EQUIPMENT*

- A. Salvaged equipment, as identified on the drawings, shall be delivered to the Owner at a designated site within the project site. Salvaged equipment shall be placed on wood or concrete blocks so the equipment will be 4 inches minimum above ground elevation.

3.5 *ORDER OF WORK*

- A. See Section 01 14 00.

3.6 *PRESERVATION*

- A. If indicated or required, preserve trees, plants, rock outcroppings, or other features designated to remain. Protect trees and plants from damage; fell trees in a manner which shall not injure standing trees, plants and improvements which are to be preserved.

3.7 *RESTORATION*

- A. All demolition areas, staging/stockpiling, and open excavations shall be filled in accordance with the Earthwork Sections. Fill all open excavations deeper than one foot to an elevation to match the surrounding topography.
 - 1. New Construction Areas: As shown on drawings.

3.8 *DISPOSAL*

- A. As specified in Section 01 50 00.

END OF SECTION

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SECTION 03 30 01

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Work required under this section consists of furnishing all materials, supplies, equipment, tools, transportation, and facilities, and performing all labor and services incidental to furnishing and installing concrete work as described in this section of the Specifications or shown on the accompanying Plans. The work shall include, but is not necessarily limited to:
 - 1. All form work including special forms as required for any special construction and/or to accommodate the work of others and removal of forms.
 - 2. All concrete reinforcement, placement, bending and forming thereof.
 - 3. All concrete and cement finishing, all surface treatment and curing including non-slip finishes.
 - 4. Installation of all reglets, bolts, anchors, cans, sleeves, column bolts, etc., whether furnished under this section or by others.
 - 5. The furnishing of all items required to be or shown on the Plans as embedded in concrete, which are not specifically required under other sections.
 - 6. Setting headers and screens finishing, curing, and protecting concrete.
- B. Where prior inspection and test of materials are required, documentary evidence, in the form of test reports, shall be furnished prior to the time the material is incorporated into the work. All rejected material shall be promptly removed from the premises.

1.2 RELATED WORK

- A. Section 01 33 00 – Submittal Procedures
- B. Section 09 90 00 – Painting and Coating
- C. Section 40 05 97 – Hangers and Supports for Process Piping

1.3 REFERENCES

- A. American Concrete Institute (ACI)
- B. American Society for Testing and Materials (ASTM)
- C. State Standard Specifications
- D. California Building Code (CBC)

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1.4 DEFECTIVE WORK

- A. Work considered to be defective may be ordered, by the Engineer, to be replaced in which case the Contractor shall remove and replace the defective work at his expense. Work considered to be defective shall include, but not be limited to, the following:
1. Concrete incorrectly formed, or not conforming to details and dimensions on the Plans or with the intent of these documents, or concrete surfaces of which are out of plumb or level.
 2. Concrete in which defective or inadequate reinforcing steel has been placed.
 3. Concrete containing wood, cloth, or other foreign matter, rock pockets, voids, honeycombs, cracks or cold joints not scheduled or indicated on the Plans.
 4. Concrete below specified strength.
 5. As detailed in Section 63-1.05 of the State Standard Specifications.

1.5 SUBMITTALS

- A. Submittals shall be in accordance with the General Provisions and Section 01 33 00.
- B. Submit a complete concrete mix design that complies with the requirements for each class of concrete identified in Part 2. At a minimum the submittal shall indicate the following:
1. The expected 30 days compressive strength calculations based on the mix being proposed.
 2. Test records of the actual compressive strength achieved for a reference mix design similar to the mix being proposed.
 3. The submittal shall indicate the total weight and percentage of all cement, aggregates, water and any additional admixtures or components required for 1 cubic yard of concrete.
 4. The submittal shall clearly indicate the water to cement ratio of the proposed mix.
 5. The submittal shall include a sieve analysis to identify the size distribution of the proposed coarse and fine aggregates.
 6. If fly ash is proposed submit a certificate of compliance with ASTM C618.
- C. Provide material certificates, shop fabrication and placement drawings, and schedule for all reinforcing steel, imbedded items, form release and curing compounds.
- D. The Contractor shall provide a proposed concrete placement plan (to minimize the effects of cracking and differential settlement) to the Engineer, and gain approval of

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said plan, prior to ordering of reinforcing steel. As a minimum this plan shall contain the layout of horizontal and vertical construction joints, spaced no greater than 50 feet apart (unless specifically approved otherwise by the Engineer), and a pour schedule for the individual slab and wall pours. All construction joints shall be sized in conformance with the Typical Longitudinal Keys Detail and shall contain water stops as shown on the Construction Joint With Waterstop Detail.

PART 2 PRODUCTS

2.1 CONCRETE

- A. Concrete shall conform to Section 90 of the 2010 State Standard Specifications. Unless otherwise shown or specified, all concrete shall comply with the following requirements:
 - 1. Concrete shall not contain less than 564 pounds of Portland cement per cubic yard of concrete (6-sack) with a minimum 28-day compressive strength of 4,000 psi.
 - 2. Portland cement shall be Type II
 - 3. Concrete shall contain 4% \pm 1% entrained air.
 - 4. Water/cement ratio shall not exceed 0.45 (by weight).
 - 5. Slump at placement shall be 4 inches.
- B. Concrete used for sidewalks, paving, thrust blocks, and pipe encasement shall comply with the previous requirements except:
 - 1. The concrete shall contain not less than 470 pounds of Portland Cement per cubic yard of concrete (5-sack) with a minimum 28-day compressive strength of 3,000 psi.
- C. Slurry cement backfill used in lieu of compacted soil shall contain not less than 188-pounds of Type II Portland Cement per cubic yard of concrete (2 sack) and shall comply with Section 19 of the State Standard Specifications.

2.2 AGGREGATE

- A. Aggregate for normal weight concrete shall conform to ASTM C-33. Aggregates shall be free of dirt, clay balls, roots, bark and other deleterious substances and shall be thoroughly washed before use.
- B. The combined aggregates for concrete shall conform to the grading limits for the one inch, maximum size specified in Section 90-3.04 of the State Standard Specifications, Combined Aggregate Gradings.

2.3 *WATER*

- A. Water shall be clean and free from injurious amounts of acids, alkalis, salts, oils, organic materials or other deleterious substances.

2.4 *FLYASH*

- A. Fly Ash: ASTM C618, Class F
 - 1. Type of fly ash shall be compatible with the type of cement and the intended use of the concrete.
- B. The combined weight of fly ash conforming to ASTM C618 shall not exceed 15 percent of the total cementitious material.
 - 1. When substituting fly ash for cement, 1.5 pounds of fly ash shall be used in place of each pound of cement.

2.5 *ADMIXTURES*

- A. Air Entraining: ASTM C260
- B. Water Reducing: ASTM C494, Type A or D
- C. Accelerating: ASTM C494, Type C or E
 - 1. No admixture containing any chloride ions is acceptable.
- D. Retarding: ASTM C494, Type B or D

2.6 *REINFORCING STEEL*

- A. Rebar shall be ASTM designation A615, Grade 60.
- B. Welded wire fabric shall conform to ASTM A 185.

2.7 *EXPOSED-TO-VIEW CONCRETE*

- A. For exposed-to-view concrete, where legs of metal supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class I).
- B. Metal bar supports in slab covers for sewage-containing structures shall also be provided with plastic coated legs.

2.8 *FORM MATERIALS*

- A. Exposed Concrete: Plywood complying with U.S. Plywood Standard PS-1 "BB (Concrete Form) Plywood" Class I, or better.
- B. Textured Finish Concrete: Units of face design, size arrangement and configuration to match control sample.

- C. Cylindrical Columns and Supports: Metal, fiberglass or waxed paper tubes of sufficient wall thickness to resist imposed loads without deformation.
- D. Form Release Agent shall leave behind a paintable concrete surface.
 - 1. Release #1, The Burke Co., or Engineer approved equivalent.

2.9 CURING MATERIALS

- A. Polyethylene film
- B. Reinforced waterproof paper
 - 1. Sisal Kraft, Orange Label, or approved equal.
- C. Liquid-membrane curing compound
 - 1. Curing compound shall comply with ASTM C309, Type 2.
 - a. White pigmented material
 - b. Clear pigment may be used for concrete that will be exposed to public view.

PART 3 EXECUTION

3.1 REINFORCING STEEL

- A. Comply with CRSI, "Placing Reinforcing Bars" and as specified herein.
- B. Place reinforcing steel and embedded items in accordance with approved shop drawings.
- C. Splicing of bars shall be by lapping. Lapped splices shall be 45 bar diameters for bar size through #8 and 60 bar diameters for larger bars, unless otherwise shown on the Plans.
- D. Splicing of the wire fabric shall be by lapping. Lapped splices shall be two full mesh, minimum.
- E. All rebar in vertical walls shall be supported by concrete block spacers or metal chairs.
- F. Prior to placement of the concrete, reinforcing steel shall be cleaned and free of all concrete, dirt, oil, mill scale, rust or other coatings that would reduce or destroy the bond.
- G. All reinforcing steel and embedded items shall be reviewed and approved by the Engineer prior to concrete placement.

3.2 FORMS

- A. All forms shall be cleaned and an approved agent applied each time they are used and shall be so constructed and set as to resist, without springing or settlement, the pressure of the concrete and the placing operations.
- B. In designing forms and falsework, the concrete shall be treated as a liquid weighing at least 150 lbs. per cubic foot for vertical loads and not less than 85 lbs. per cubic foot for horizontal pressure. The design of the forms and falsework system shall include allowances for temporary construction loads. The rate of placement of concrete shall be so regulated that the pressures caused by the wet concrete will not exceed the designed form pressure. The unsupported length of wooden columns and compression members shall not exceed 30 times the width of the least side.
- C. All forms shall be set and maintained in true alignment, grade and section until the concrete has sufficiently set. The interior surfaces of forms shall be adequately treated with an acceptable material to insure non-adhesion of mortar. All forms shall be mortar-tight. When forms appear to be unsatisfactory in any way, concrete placement shall be stopped until the defects have been corrected.
- D. All exposed outside corners, including the top edges of all walls, machinery bases and curbs shall have a $\frac{3}{4}$ -inch chamfer.
- E. Metal tie rods or anchorages within the forms shall be fitted with suitable cones or comparable devices. Metal tie rods or anchorages shall be removed to a depth of 1" from the surface without injury to the concrete. All fittings for metal ties shall be of such design that upon their removal, the cavities which are left will be of the smallest possible size, but of sufficient diameter to allow the cavity to be "dry packed" with cement mortar. The cavities shall be filled with cement mortar and the surface left sound, smooth and even.
- F. Form release agent shall be applied to the form so that no agent comes in contact with reinforcing steel.

3.3 PLACING

- A. All concrete shall be placed before it has taken its initial set and shall be placed in horizontal layers and in such a manner as to avoid segregation. The concrete adjacent to the forms and joints shall be thoroughly internal consolidated with a vibrator operating at not less than 4,500 vibrations per minute.
 - 1. Pumping equipment shall be of suitable type, without Y-sections, and with adequate pumping capacity.
 - 2. Loss of slump in pumping shall not exceed $1\frac{1}{2}$ ".
 - 3. Concrete shall not be placed through reinforcing that may cause separation of aggregates.

- B. The concrete shall be deposited as nearly as possible in its final position. Drop chutes and elephant trunks shall be used on drops greater than 5 feet. Concrete shall be placed at such a rate that all concrete in the same lift will be deposited on plastic concrete. The concrete comprising each unit of work shall be placed in a continuous lift.
- C. The Contractor shall notify the Engineer 24 hours (1 working day) prior to concrete placement.
 - 1. The form work and reinforcing steel placement shall be approved by the Engineer prior to ordering concrete.
- D. Form Removal. Minimum times for removal after concrete placement are as follows:

Beam sides but not shoring	3 days
Column forms and wall forms	2 days
Forms for supported slabs but not shoring	14 days
- E. Construction Joints
 - 1. At ends of the first concrete pour, provide forms that positively locate any waterstop. Ensure the end forms of walls are removable without releasing the side forms. Provide seals around reinforcement and water stop to prevent mortar leaks.
 - 2. Overlap the hardened concrete of the first pour with forms for the second pour. Brace the ends of the forms against the hardened concrete to prevent joint offsets and mortar leakage. Align any exterior features required on the finished surface.

3.4 CONCRETE JOINTS

- A. General
 - 1. Provide joints:
 - a. As shown on the Drawings and as noted below in these Specifications.
 - b. As required for constructability
 - c. After favorable review of layout, sequence and concrete placement program.
 - 2. Provide minimum curing times before the second placement:
 - a. 2 days after the first concrete placement at the joint.
 - b. 10 days after each adjacent concrete placement, for infill pours or checkerboard placement pattern.

B. Control Joints:

1. Space typical control joints in slabs on grade or suspended slabs not exceeding 20 feet, or as shown on the Drawings. Control joints shall not be provided in the equipment foundations.
2. If cast-in with the concrete, positively locate the preformed joint filler and hold rigidly in place during concreting.
3. If saw-cut, use a wheeled power saw as soon as the concrete surface is firm enough. Saw-cut control joints must be constructed within 12-hours after concrete placement. Fill the groove with sealant over a backer rod.

C. Construction Joints:

1. Produce quality concrete, with full continuity of reinforcing and water tightness across the joints.
2. Space typical slab joints not exceeding 20 feet in the direction of the transverse or secondary reinforcing, typically the smaller reinforcing nearer to the center of the slab thickness. Space typical vertical wall joints no more than 30 feet apart.
3. Provide all joints in walls and slabs, retaining liquids, or earth with 6-inch waterstops. Continue all reinforcing through the joint unless otherwise noted.
4. After the first concrete placement at the joint, do not walk on or disturb any reinforcing extending into the second placement area for at least 48 hours.
5. Before depositing new concrete on or against concrete that has hardened, clean and roughen the entire surface of the joint exposing clean coarse aggregate solidly embedded in mortar matrix. Provide typically 1/4-inch roughness or amplitude of the concrete surface measured from the top of the exposed aggregate to the bottom of pockets between stones.
6. Drench the prepared joint with clean water and remove prior to the concrete pour.
7. Cover horizontal wall joints and wall-to-slab joints with a minimum thickness of 2 inches and a maximum of 6 inches of the modified concrete mix, consisting of the designated concrete mix with one-half of the coarse aggregate removed.
8. Use special care in vibrating adjacent to construction joints to ensure thorough consolidation of the concrete around the waterstops and against the hardened portion of the joint. Additional hand tamping may be required.
9. For joints that are shown on architectural drawings as having a continuous reveal or recess, leave the wood form or pour strip used to create the reveal

or recess in place or re-insert before roughening. Prevent the next concrete placement from filling the reveal or recess.

D. Expansion Joints

1. Stop all steel reinforcing clear of the joint at each side.
2. Provide 9-inch center bulb waterstop continuously around the joint in walls and slabs retaining liquids.
3. Prepare a smooth first concrete surface with all voids filled.
4. Provide preformed joint filler, securely fastened to the existing concrete as directed by the Manufacturer.
5. Install bond breaker and sealant after curing is completed and when directed.

E. Bonding to Pre-existing Concrete: Mechanically roughen the old surface to a 1/4-inch amplitude, as defined in construction joint paragraph above. Apply epoxy bonding material prior to concreting, as recommended by the manufacturer.

F. Waterstop

1. Restrict field splices to butt joints in straight runs. For PVC type, make by heat welding, using a splicing iron. For rubber, provide sleeve joints and glue. Follow the manufacturer's specifications.
2. Positively locate and support in the forms so that concrete may be placed, consolidated, and vibrated on both sides of the embedded portion without displacement of the waterstop and without causing voids in the concrete. Protect the outstanding portion from damage during the first concrete pour and clean and positively support prior to the second pour. Place, consolidate and vibrate the second pour without displacement of the waterstop and without causing voids in the concrete.

3.5 CONCRETE CURING

- A. Exposed concrete surfaces shall be protected from premature drying by covering as soon as possible with canvas, plastic sheets with sealed joints, burlap, sand or other satisfactory materials and kept continuously moist; or, if the surfaces are not covered, they shall be kept continuously moist by flushing or sprinkling.
1. Curing shall continue for a period of not less than 7 days after placing the concrete. If curing compound is used, two (2) applications will be made for even coverage. Curing methods must be approved by the Engineer.

3.6 FINISHING

- A. Defective and honeycombed surfaces shall be chipped back to such a depth to expose solid concrete. The surface shall be dampened and coated with a bonding agent and packed with mortar.

B. Concrete Finishes for Vertical Wall Surfaces:

1. Form facing material shall produce a smooth, hard, uniform texture.
 - a. Use forms specified for surfaces exposed to view in accordance with the Plans and other Specification Sections.
2. At a minimum, repair the following surface defects:
 - a. Tie holes
 - b. Honeycombs deeper than $\frac{1}{4}$ "
 - c. Air pockets deeper than $\frac{1}{4}$ "
 - d. Rock holes deeper than $\frac{1}{4}$ "
 - e. Scabbing
3. Chip or rub off fins exceeding $\frac{1}{8}$ " in height.
4. Provide SF/ESF 3.0 finish and a smooth-rubbed finish for:
 - a. Walls being waterproofed, painted, coated with some other material.
 - b. Use at all exposed surfaces not specified to receive another finish.

C. Related Uniform Surfaces (Except Slabs):

1. Strike smooth tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces after concrete is placed.
2. Float surface to a texture consistent with that of formed surfaces.
3. Continue treatment uniformly across unformed surfaces.

D. Concrete Finishes for Horizontal Slab Surfaces:

1. General: Tamp concrete to force coarse aggregate down from surface. Screed with straightedge, eliminate high and low places, bring surface to required finish elevations; slope uniformly to drains. Dusting of surface with dry cement or sand during finishing processes not permitted.
2. Slab Finish shall be as follows:
 - a. Surfaces intended to receive damp proofing or water proofing membranes: Float finish.
 - b. Floors intended to receive floor coverings and MCC rooms: Trowel finish.

- c. Sidewalks, garage floors, drive-throughs and ramps: Broom finish.
 - d. Exterior slabs, platforms, steps and landings, exterior and interior pedestrian ramps and interior stairs and all process equipment areas, not covered by other finish materials: Broom finish.
- 3. Deviation in finish surface shall not exceed 1/4" in 10 ft.
 - 4. No tolerance will be allowed that will result in the maximum running, or cross, slope exceeding the requirements of the Americans with Disabilities Act.

3.7 TESTING

- A. Testing of concrete shall be as required by the Engineer and in accordance with ACI 301, Chapter 1.6.
 - 1. All costs of initial testing will be paid by the Owner unless otherwise noted.
 - 2. All costs involved, including those required by the Engineer, in retesting of concrete required because of a failure to meet these Specifications shall be at the expense of the Contractor.

3.8 WATERTIGHTNESS OF CONCRETE WORK

- A. It is the intent of this Specification to obtain concrete and grout with homogenous structure, which when hardened will have the required strength, is watertight, and resistance to weathering.

3.9 HYDRAULIC TESTINGS OF STRUCTURES

- A. It is the intent of this Specification to obtain concrete and grout with homogenous structure, which when hardened will have the required strength, watertightness, and resistance to weathering.
- B. General: Test all concrete tanks, hydraulic channels, sumps, basins and other structures designed to contain water, after concrete has reached the design strength, prior to backfilling, and application of any coating system. Test shall be performed by filling the structure with water.
- C. Preparation: Provide the following.
 - 1. All water necessary for testing shall be of acceptable Quality.
 - 2. All evaporation and level measuring devices required.
 - 3. All pumps, power, piping and any other equipment required. Make all hook-ups necessary to fill tanks for testing.
 - 4. The water disposal method after testing is complete, including pumping if necessary.

5. Fill the structure with water to the extreme high operating surface level or to overflow weir level. Furnish and install temporary bulkheads, if required.
 6. Maintain full for 48 hours before beginning the test period to permit concrete absorption and adjustment of valves, slide gates, or temporary bulkheads.
 7. At completion of tests remove all temporary piping and connections. Dispose of wastewater without creating a nuisance of damage to adjacent property.
- D. Test Period: Five consecutive 24 hour periods totaling 5 consecutive days. Take daily measurements of air and water temperature, rainfall and water level.
- E. Test Procedure:
1. After test period, measure water level at each side of the tank to determine leakage and loss from evaporation.
 2. Determine evaporation loss, using a standard 48-inch evaporation pan and level measuring device located adjacent to the tank.
 3. Mark all observed damp areas, running or dripping leaks on exposed surfaces that have not healed autogenously during the test. Damp areas includes areas if moisture can be transferred from the exterior surface to a dry hand. Repair all those areas.
 4. If leakage from the structure exceeds that permitted for the types of mechanical equipment providing closure plus 0.075% of the storage capacity, in each 24-hour period over a period of five consecutive days, perform a retest after completing repairs.
 5. Provide acceptable procedures prior to repairs. Repairs by painting or surface treatment will not be acceptable.
 6. Continue the test and repair procedure until the structure satisfies both the leakage calculation requirement and the visible leakage requirement.
- F. Test for Manholes
1. Furnish and dispose of water used for testing.
 2. Hydraulically test all manholes installed.
 3. After all pipe has been laid, backfilling has been completed, and after the testing of the pipes, plug the end of the pipe stubs in each manhole with flexible-joint caps, or acceptable alternate, securely fastened.
 4. Fill the manhole with water and measure leakage over a period of not less than one hour.
 5. Allowable Leakage: less than one (1) gallon per hour per 10-foot depth of manhole.

6. When leakage from the manhole exceeds the above amount, determine the source or sources of the leakage, and repair or replace defective materials and workmanship.
7. Repair all visible leaks even if manhole passes the leakage test.

END OF SECTION

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SECTION 05 05 20

BOLTS, WASHERS, ANCHORS AND EYEBOLTS

PART 1 GENERAL

1.1 WORK INCLUDED

- A. This section describes materials and installation of anchor bolts, connecting bolts, washers, drilled anchors, epoxy anchors, screw anchors, eyebolts, and stainless steel fasteners.

1.2 RELATED WORK

- A. Section 01 33 00 – Submittals
- B. Section 01 43 00 – Quality Control Testing

1.3 REFERENCES

- A. American Institute of Steel Construction (AISC)
- B. American Society for Testing and Materials (ASTM)
- C. Research Council on Structural Connections (RCSC)

1.4 DESIGN CRITERIA

- A. Structural Connections: AISC Specification for Structural Steel Buildings (June 22, 2010), except connection details are shown in the Drawings.

1.5 SUBMITTALS

- A. Submit shop drawings in accordance with Section 01 33 00.
- B. Submit manufacturer's catalog data and ICC Evaluation Service Reports for bolts, washers, and concrete anchors. Show dimensions and reference materials of construction by ASTM designation and grade.
- C. Submit anchor bolt layout drawings.

PART 2 PRODUCTS

2.1 GENERAL

- A. Anchor bolts, drilled anchors and epoxy anchors for buried service, immersion service, equipment anchorage, and in splash zones shall be stainless steel. All other anchor bolts, drilled anchors and epoxy anchors shall be galvanized steel unless otherwise specified on the Plans.

BOLTS, WASHERS, ANCHORS AND EYEBOLTS
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2.2 *BOLT AND ANCHOR BOLT MATERIALS*

- A. Bolts, anchor bolts, washers and nuts shall be fabricated from the following materials. Size, embedment, length and thread length shall be as shown on the Drawings.
- B. Galvanized Steel
 - 1. Bolts, anchor bolts, nuts and washers shall be galvanized per ASTM F2329.
 - 2. Bolts and anchor bolts shall conform to ASTM F1554, Grade 36, Class 1A or 2A unless otherwise indicated.
 - 3. Nuts shall conform to ASTM A563, Grade A, hex shaped, threaded to match the bolt.
 - 4. Washers shall be square or rectangular, tapered in thickness, smooth, hot-dipped galvanized, conforming to ASTM F436, Type 1.
- C. Type 304 Stainless Steel
 - 1. Bolts and anchor bolts shall conform to ASTM F593, Group 1, cold worked unless otherwise indicated.
 - 2. Nuts shall conform to ASTM F594. Threads and alloy and shall match the bolt.
 - 3. Washers shall be Type 304 stainless steel.
- D. Type 316 Stainless Steel
 - 1. Bolts and anchor bolts shall conform to ASTM F593, Group 2, cold worked unless otherwise indicated.
 - 2. Nuts shall conform to ASTM F594. Threads and alloy and shall match the bolt.
 - 3. Washers shall be Type 316 stainless steel.

2.3 *ANCHOR BOLTS*

- 1. Bolts shall be provided with a hex forged head and two washers of a minimum of ¼ inch thick and 2 inches square. One washer shall be embedded in the concrete at the head of the bolt. Washers shall match the material of the bolt.

2.4 *LUBRICANT FOR STAINLESS STEEL BOLTS AND NUTS*

- A. Lubricant shall be chloride free and shall be RAMCO TG-50, Anti-Seize by RAMCO, Huskey™ Lube-O-Seal by HUSK-ITT Corporation, or equal.

2.5 DRILLED ANCHORS

- A. Drilled anchors shall be wedge anchors fabricated from Type 316 stainless steel per the requirements of this section as manufactured by ITW Red Head Trubolt+, Kwik Bolt TZ by Hilti, or equal. Anchors shall have ICC-approved testing.

2.6 EPOXY ANCHORS

- A. Epoxy anchors in concrete shall be threaded rod fabricated from Type 316 stainless steel per the requirements of this section. Adhesive shall be ITW Red Head Epcon S7, Hilti HIT RE 500-SD, or equal. Epoxy anchor assemblies shall be ICC approved.
- B. Epoxy anchors in grouted concrete masonry walls shall be threaded rod fabricated from Type 316 stainless steel per the requirements of this section. Epoxy adhesive shall be Hilti HIT HY 70, Simpson ET-HP, or equal.

PART 3 EXECUTION

3.1 STORAGE OF MATERIALS

- A. Store material, either plain or fabricated, above ground on platforms, skids, or other supports. Keep material free from dirt, grease, and other foreign matter and protect from corrosion.

3.2 INSTALLING CONNECTION BOLTS

- A. Use steel bolts to connect structural steel members. Use stainless steel bolts to connect structural aluminum members.
- B. Install bolts and washers per the RCSC "Specification for Structural Joints Using High Strength Bolts".
- C. Bolt holes in structural members shall be 1/16 inch in diameter larger than bolt size. Measure cast-in-place bolt locations in the field before drilling companion holes in structural steel beam or assembly.
- D. Slotted holes, if required in the Drawings, shall conform to AISC 360-10, Chapter J, Section J3, Table J3.3.
- E. Drive bolts accurately into the holes without damaging the thread. Protect boltheads from damage during driving. Boltheads and nuts or washers shall rest squarely against the metal. Where bolts are to be used on beveled surfaces having slopes greater than 1 in 20 with a plane normal to the bolt axis, provide beveled washers to give full bearing to the head or nut. Where self-locking nuts are not furnished, bolt threads shall be upset to prevent the nuts from backing off.
- F. Bolts shall be of the length that will extend entirely through but not more than ¼ inch beyond the nuts. Draw boltheads and nuts tight against the work.

3.3 *INSTALLATION OF STAINLESS STEEL BOLTS AND NUTS*

- A. Prior to assembly, coat threaded portions of stainless steel bolts and nuts with lubricant.

3.4 *INSTALLING ANCHOR BOLTS*

- A. Anchor bolts shall be delivered in time to permit setting before the structural concrete is placed. Anchor bolts which are cast in place in concrete shall be provided with sufficient threads to permit a nut to be installed on the concrete side of the concrete form or supporting template.
- B. Preset bolts and anchors by the use of templates. Do not use concrete anchors set in holes drilled in the concrete after the concrete is placed for mechanical equipment. Anchor bolts and threaded rod anchors which are to be epoxy grouted shall be clean and free of coatings that would weaken the bond with epoxy.
- C. Two nuts, a jam nut, and a washer shall be furnished for anchor bolts and threaded rod anchors indicated on the drawings to have locknuts; two nuts and a washer shall be furnished for all other anchor bolts.
- D. Anti-seize thread lubricant shall be liberally applied to projecting, threaded portions of stainless steel anchor bolts and threaded rod anchors immediately before final installation and tightening of the nuts.
- E. For static items such as storage tanks, use preset anchor bolts or drilled anchors with ICC report data.
- F. After anchor bolts have been embedded, protect projecting threads by applying grease and having the nuts installed until the time of installation of the equipment or metalwork.

3.5 *INSTALLING DRILLED ANCHORS*

- A. Minimum depth of embedment of drilled mechanical anchors shall be as recommended by the manufacturer, but no less than that shown in the Drawings.
- B. Prepare holes for drilled anchors in accordance with the anchor manufacturer's recommendations prior to installation.

3.6 *INSTALLING EXPOXY ANCHORS*

- A. Epoxy anchors shall be clean and free of coatings that would weaken the bond with epoxy.
- B. Minimum depth of embedment of epoxy anchors shall be as recommended by the manufacturer, but no less than that shown in the Drawings.
- C. Prepare holes for epoxy anchors in accordance with the anchor manufacturer's recommendations prior to installation.

END OF SECTION

BOLTS, WASHERS, ANCHORS AND EYEBOLTS
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SECTION 09 90 00

PAINTING AND COATING

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Field painting including surface preparation, surface protection, clean up, and/or other appurtenant work.
- B. All labor, materials, tools and equipment, and incidentals necessary and required for their completion.
- C. All new pipe, fittings, other equipment, and structures are to be field coated except for those specific exceptions contained in this specification or identified on the drawings. The painting schedule included at the end of this specification summarizes the surfaces to be coated, the required surface preparation, and the coating systems to be applied. Coating notes on the drawings are used to show exceptions to the schedules, to extend the limits of coating systems, or to clarify or show details for application of the coating systems.
- D. Portions of the Residuals Dewatering Equipment and appurtenances will be delivered to the job site finish coated. The Contractor shall be responsible for touch-up coating of any factory applied coatings that are damaged during offloading or installation.

1.2 RELATED WORK

- A. Section 01 33 00 – Submittal Procedures
- B. Section 09 97 61 – Fusion Bonded Epoxy

1.3 SUBMITTALS

- A. Submittals shall be in accordance with the General Conditions and Section 01 33 00.
 - 1. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Performance criteria as required by the Engineer to determine quality.
 - c. Manufacturer's installation instructions and environmental parameters.
 - d. Material Safety Data Sheets.
 - e. Color samples.

1.4 AIR QUALITY REGULATORY COMPLIANCE

- A. All paint shall conform to the applicable air quality regulations at the point of application. Any paint material which cannot be guaranteed by the manufacturer to comply, whether specified by product designation or not, shall not be used.
- B. The volatile organic compound (VOC) of coatings materials limits set forth in Rule 460.1 of the San Joaquin Valley Unified Air Pollution Control District shall apply to this project. The manufacturers' products listed in paragraphs 09 90 00-2.3, 2.4, and 2.5 have been selected on the basis of their apparent compliance with Rule 460.1; however, it shall remain the Contractor's responsibility to ensure that all coatings materials furnished are in compliance with all regulatory agencies.
- C. The product listed may meet the VOC requirement in the unthinned (as shipped) condition, but may exceed the VOC requirement if thinned to the manufacturer's allowable recommendations. In this situation, the product is not to be thinned beyond the limit indicated in Rule 460.1, and if the product cannot be suitably thinned for the intended application method or temperature requirements, it will be necessary to use another manufacturer's product subject to acceptance by the Engineer.
- D. It shall be the responsibility of the Contractor to ensure the compatibility of the field painting products which will be in contact with each other or which will be applied over shop painted or previously painted surfaces. Paint used in successive field coats shall be produced by the same manufacturer. Paint used in the first field coat over shop or field primed surfaces, or previously painted surfaces shall cause no wrinkling, lifting, or other damage to underlying paint.
- E. Paint shall be lead-free and mercury-free.

1.5 QUALITY OF WORK

- A. All finishes shall be applied by skilled workmen in accordance with the best practices and standards of the painting trade. Brushes, rollers, all equipment, and the techniques used in applying finishes shall be of sufficient quality to assure the specified results. Work not conforming to this Specification shall be corrected by touching up or refinishing as directed by the Engineer.
- B. It is the purpose and intent of this Specification to cover the complete paint finishing of all exterior and interior surfaces as scheduled or specified and all surfaces which normally require a paint finish for corrosion resistance, weather protection, finished appearance or utility. Finished surfaces shall be of the type of finish, color sheen film thickness and quality specified.

1.6 DELIVERY AND STORAGE

- A. Painting materials shall be delivered to site in manufacturer's original containers with labels intact and seals unbroken. Painting materials and equipment shall be stored and protected against freezing and mixed in rooms assigned for that purpose. No chemicals, unauthorized thinners, or other materials, not included in the paint formulation shall be added to the paint for any purpose. All necessary precautions

shall be taken to prevent fire. Rags or waste soiled with paint shall be removed from premises at end of each day's work, or shall be stored in covered metal containers.

1.7 *EQUIVALENT PRODUCTS*

- A. Whenever a coating is specified using the name of a proprietary product or the name of a particular manufacturer or vendor, the specified coating shall be understood as establishing the type and quality of coating desired.
- B. Other manufacturers' products will be accepted provided sufficient information is submitted to allow the Engineer to determine that the coatings proposed are equivalent to those named. Proposed coatings shall be submitted for review in accordance with the General Conditions.
- C. Requests for review of equivalency will not be accepted from anyone except the Contractor, and such requests will not be considered until after the contract has been awarded.
- D. Specific products for various applications shall be as specified in Part 2. In addition to the products named in Part 2, equivalent products of the following manufacturers will also be acceptable:

Ameron
Carboline
Devoe
PPG (Pittsburgh)
Sherwin Williams Co.
Sinclair
Tnemec
Valspar

- E. Contractor shall provide verification that equivalent products are acceptable for the desired application.

1.8 *REFERENCE STANDARDS*

- A. SSPC – Society of Protective Coatings, Pittsburgh, PA
- B. ASTM – American Society For Testing And Materials, West Conshohocken, PA

PART 2 PRODUCTS

2.1 *GENERAL*

- A. All paint shall be the product of a recognized manufacturer exclusively engaged in the manufacture of painting material. All paints for wood and metal surfaces shall be well-ground and shall not skin, liver, curdle, or body excessively in the containers.

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- B. The paint shall not show laps or unevenness of color or texture. When applied to vertical surfaces, it shall not sag.
- C. All exposed surfaces, including sides and edges, shall be painted. Hangers, brackets, fastenings and other miscellaneous items shall be painted with the same system as the adjacent material. Paint systems shall be in addition to shop primers.
- D. Paint shall be stored inside and shall be protected against freezing. No adulterant, unauthorized thinner, or other material not included in the paint formation shall be added to the paint for any purpose.
- E. Paint used in successive field coats shall be produced by the same manufacturer. Paint used in the first field coat over shop painted or previously painted surfaces shall cause no wrinkling, lifting, or other damage to underlying paint. Any paint system shall be the product of a single manufacturer.
- F. All paint used for intermediate and finish coats shall be guaranteed by the paint manufacturer to be lead-free, mercury-free, and fumeproof. Where paint materials are referenced to Federal or military specifications, the reference shall define general type and quality required but is not intended to limit acceptable materials to an exact formulation.
- G. For each paint, the Contractor shall follow the paint manufacturer's specific application instructions. Upon the Engineer's request, the Contractor shall furnish the following application instructions.
 - 1. Surface preparation recommendations.
 - 2. Type of primer to be used.
 - 3. Maximum dry and wet mil thickness per coat.
 - 4. Minimum and maximum curing times between coats.
 - 5. Thinner to be used with each paint.
 - 6. Ventilation requirements.
 - 7. Atmospheric conditions during which the paint shall not be applied.
 - 8. Allowable methods of application.
 - 9. Maximum allowable moisture content and minimum age of plaster, concrete and wood surfaces at time of paint application.
 - 10. Curing time before submergence in water.
- H. The minimum number of coats and minimum total dry mil thickness of the system for each surface shall be as specified in the paint schedule.

2.2 PAINTING SCHEDULE

- A. A schedule is appended to this section listing the surface preparation, primer, finish and dry mil thickness to be used on each surface to be coated.

2.3 PRIMERS AND PRETREATMENT

- A. P-1 Epoxy Primer - Minimum dry thickness 4 mils. Devoe "Bar Rust 235H", Sherwin Williams "Macropoxy 646 FC Epoxy B58-600", or Tnemec 69-1211 "Hi-Build Expoxoline."
- B. P-2 Rust Inhibitive, non-submerged - Minimum dry thickness 3 mils. Devoe "Devran 203 Waterborne Epoxy Primer", Sherwin Williams "Macropoxy 646 FC Epoxy B58-600" or Tnemec 135 "Chem Build."
- C. P-3 Rust inhibitive, submerged - Minimum dry thickness 4.0 mils. Devoe "Bar Rust 235H", Sherwin Williams "Macropoxy 646 FC Epoxy B58-600" or Tnemec 136 "Chem Build."
- D. P-4 Primer for Wood – Maximum of 400 sq. ft/gal. Devoe 2010-1200 "Ultra- Hide Durus Exterior Acrylic Primecoat", Sherwin Williams "A-100 Wood Primer B42W41" or Tnemec 151 "Elaso-Grip."
- E. P-5 Wallboard Primer – Maximum of 400 sq. ft/gal. Devoe 1060-1200 "Ultra- Hide Latex Primer- Sealer", Sherwin Williams "Preprite 200 Interior Latex Primer B28W200", or Tnemec 51-792 "PVA Sealer."
- F. P-6 High Build Acrylic – Maximum of 100 sq. ft/gal., Tnemec 180 WB Tneme-Crete, Sherwin Williams "Heavy Duty Block Filler B42W46".

2.4 INTERMEDIATE AND FINISH PAINTS

- A. F-1 Epoxy Resin - Minimum dry thickness 5 mils. Devoe "Bar Rust 235H", Sherwin Williams "Macropoxy 646 FC Epoxy B58-600", or Tnemec 69 "Hi-Build" epoxy.
- B. F-2 Gloss Acrylic Emulsion - Minimum dry thickness 2.0 mils Devoe " Devflex 4208 Waterbone Acrylic Enamel", Sherwin Williams "Shercryl Hi Performance Acrylic Gloss B66-300", or Tnemec 1028.
- C. F-3 Semi-gloss Acrylic Emulsion - Minimum dry thickness 2.5 mils Devoe "Devvflex 4216 HP Waterborne", Sherwin Williams "Shercryl Hi Performance Acrylic Semi-Gloss B66-350", or Tnemec 1029 "Tuf Cryl".
- D. F-4 High Build Epoxy (Substitute for Coal Tar) - Minimum dry thickness 6 mils. Devoe "Devtar 5A HS", Sherwin Williams "Targuard Coal Tar Epoxy B69B60", or Tnemec "V69F Black"
- E. F-5 Polyurethane O - Minimum dry thickness 2 mils. Devoe "Devthane 379H Aliphatic Urethane Gloss Enamel", Sherwin Williams "Hi Solids Polyurethane CA B65j-300", or Tnemec 1075 "Endurasheild."

- F. F-6 Acrylic Epoxy – Minimum dry film thickness 4 mils. Tnemec 113 Tneme-Tufcoat, Sherwin Williams “ Waterbased Tile Clad Epoxy B73-100”.
- G. F-7 High Build Acrylic – Maximum of 100 sq. ft./gal. Tnemec 180 WB Tneme-Crete, Sherwin Williams “Heavy Duty Block Filler B42W46”.

2.5 *FUSION BONDED EPOXY LINING AND COATING*

- A. Per Section 09 97 61.

2.6 *ALUMINUM SURFACES*

- A. All aluminum in contact with steel or concrete: Sherwin Williams “Macropoxy 646 FC Epoxy B58-600 series or approved equivalent..

2.7 *SHOP COATINGS*

- A. Shop coatings shall be applied as indicated in the individual equipment and component specifications.
- B. Electric motors, speed reducers, starters, and other self contained or enclosed components shall be shop primed or finished with a high grade, oil resistant enamel suitable for top coating in the field with an alkyd enamel.
- C. All shop coatings shall be compatible with the pain system specified in the Painting Schedule contained at the end of this specification.

2.8 *SURFACES NOT TO BE PAINTED*

- A. Except as otherwise required or directed, the following surfaces are to be left unpainted:
 - 1. Exposed surfaces of aluminum (aluminum in contact with concrete is to be coated).
 - 2. Polished or finished stainless steel.
 - 3. Nickel or chromium.
 - 4. Galvanized surfaces, except piping, conduit, electrical conduit, pipe supports, fasteners, hangers, bracing, brackets, and accessories.
 - 5. Rubber and plastics, including fiberglass reinforced plastics.
 - 6. Precast concrete.

2.9 *SYSTEM IDENTIFICATION*

- A. Above Grade Piping: Provide markers on piping which is either exposed or concealed in accessible spaces. For piping systems, other than drain and vent lines, indicate the fluid conveyed or its abbreviation, either by preprinted marker or stenciled marking, and include arrows to show the direction of flow. Comply with

ANSI A13.1 for colors. Locate markers at ends of lines, near major branches and other interruptions including equipment in the line, where lines pass through floor, walls or ceilings or otherwise pass into inaccessible spaces, and at 50' maximum intervals along exposed portion of lines. Marking of short branches and repetitive branches for equipment connections is not required.

- B. Equipment: All equipment shall be identified with a plastic laminated, engraved nameplate which bears the unit mark number as indicated on the drawings (e.g. AC-4). Provide 1/2" high lettering, white on black background. Nameplates shall be permanently secured to the unit.
- C. Valves: Provide valve tags on all valves of each piping system, excluding check valves, valves within equipment, faucets, stops and shut-off valves at fixtures and other repetitive terminal units. Provide brass tags or plastic laminate tags. Prepare and submit a tagged valve schedule, listing each valve by tag number, location and piping service. Mount in glazed frame where directed.

2.10 COLORS

- A. All colors and shades of colors shall be as specifically indicated in the specifications or plans, or, where not specifically indicated, selected from the manufacturer's standard color samples by the Owner.
- B. Electrical conduit shall be painted to match adjacent ceiling or wall surfaces as directed by the Engineer.

PART 3 EXECUTION

3.1 PRELIMINARY EXAMINATION

- A. Notify the Engineer in writing of any uncorrected defects in surfaces to be painted. Do not proceed with the finishing of surfaces in question until any discrepancies are corrected. No work on any surface shall be started, unless the surface has been inspected and approved for painting by the Engineer.

3.2 SURFACE PREPARATION

- A. The Contractor shall prepare the surfaces to be coated as specified under the paint schedule. Any surfaces to be coated which are not listed under the paint schedule shall be prepared in accordance with the manufacturer's instructions for the material to be applied.
- B. All grease, oil, dirt, and other contaminants which may affect the bond between the coating and the surface shall be removed by a cleaning agent which will leave the surface clean and dry.
- C. Cleaning and painting operations shall be performed in a manner which will prevent dust or other contaminants from getting on freshly painted surfaces.

- D. Surfaces shall be free of cracks, pits, projections, or other imperfections which would prevent the formation of smooth, unbroken paint film, except for concrete block construction where a rough surface is an inherent characteristic.
- E. When applying touch-up paint, or repairing previously painted surfaces, the surfaces to be painted shall be cleaned and sanded or wire brushed in such a manner that the edges of adjacent paint are feathered or otherwise smoothed so that they will not be noticeable when painted. All paint made brittle or otherwise damaged by heat or welding shall be completely removed.
- F. Hardware items such as bolts, screws, washers, springs, and grease fittings need not be cleaned prior to painting if there is no evidence of dirt, corrosion, or foreign material.
- G. All galvanized surfaces shall have a metal conditioner applied prior to the first prime coat.
- H. All surfaces to be finished shall be clean and dry before any materials are applied. Use a moisture meter to determine moisture content as follows. The moisture content shall be less than 18% for wood; 8% for concrete or plaster.
 - 1. Metal Surfaces - Where noted, the surface preparation for steel and other metals refer to the specifications for surface preparation by the latest revision of the Steel Structures Painting Council. All metal work shall be cleaned of grease, oil and dirt by solvent cleaning (SSPC-SP1). Do not use hydrocarbon based solvents for cleaning prior to use of acrylic materials.
 - a. Method SP-2: Surface shall be wire brushed where required to remove loose rust and dirt, etc. (SSPC-SP2)
 - b. Method SP-3: Removal of loose rust, loose mill scale and other detrimental foreign matter to degree specified by power wire brushing, power impact tools or power sanders. (SSPC-SP3)
 - c. Method SP-6: Blast cleaning until at least two-thirds of each element of surface area is free of all visible residues. (SSPC-SP6)
 - d. Method SP-10: Sandblast to near white condition. This method shall remove all rust and scale, but streaks and shadows in the metal will be acceptable. (SSPC-SP10)
 - 2. Wood Surfaces
 - a. Method W-1: All unprimed millwork delivered to the jobsite shall be given the specified first coat on all surfaces immediately upon arrival. Give all unprimed woodwork the specified first coat as soon as possible following installation. Prime any wood surface that is to be in contact with concrete, or a caulking material, with the specified first coat material before installation. Unless specified otherwise, all casings and trim, and all woodwork shall be free of oil, dirt, loose fibers, etc., sealed with a sanding sealer recommended by the coating

manufacturer, and sanded smooth and dusted thoroughly before application of the priming coat. Give all knots, pitch pockets and sappy areas a preliminary coat of Dutch Boy Knot Sealer, or approved equivalent, prior to application of the prime coat.

3. Galvanized Surfaces

- a. Method G-1: All galvanized surfaces shall be prepared for painting in strict conformity with the instructions of the manufacturer. All galvanized shall be cleaned per SSPC-SP7.

4. PVC Pipe

- a. Method V-1: All wax and oil shall be removed from PVC plastic surfaces by wiping with a solvent of the type used for the specified primer.

3.3 *PAINT APPLICATION*

- A. Apply all finishes evenly, free from sags, runs, crawls, brush marks, skips or other defects. Apply products at the proper consistency and do not thin or otherwise alter them except in accordance with the manufacturer's printed directions. All coats shall be applied in such manner as to produce an even film of uniform thickness completely coating all corners and crevices. All painting shall be done by thoroughly experienced workmen.
- B. Care shall be exercised during spraying to hold the nozzle sufficiently close to the surfaces being painted to avoid excessive evaporation of the volatile constituents and loss of material into the air, or the bridging over of crevices and corners. Spray equipment shall be equipped with mechanical agitators, pressure gauges, and pressure regulators. Nozzles shall be of proper size. Floors, roofs, and other adjacent areas and installations shall be satisfactorily protected by drop cloths or other precautionary measures. All over-spray shall be removed by approved methods or the affected surface repainted. Care shall be exercised to avoid lapping of paint on hardware of other unscheduled surfaces.
- C. Each coat of material shall be thoroughly dry before the application of a succeeding coat. In no case shall paint be applied at a rate of coverage per gallon which is greater than the maximum rate recommended by the manufacturer. Paint films showing sags, checks, blisters, teardrops, or fat edges will not be accepted. Paint containing any of these defects shall be entirely removed and the surface repainted.
- D. Sandpaper enamels and varnishes lightly between coats and dust thoroughly before the application of a succeeding coat.
- E. If the finish coat is to be colored, the prime coat and the intermediate coat shall be tinted to have a slight variation in color from each other and from the finish coat.

3.4 PRIMING

- A. Edges, corners, crevices, welds, and bolts shall be given a brush coat of primer before the specified spot or touch-up painting of metal surfaces. Special attention shall be given to filling all crevices with paint.
- B. Abraded and otherwise damaged portions of shop applied paint shall be repainted. Welded seams and other uncoated surfaces, heads and nuts of field installed bolts, and surfaces where paint has been damaged by heat, shall be given a coat of the specified primer. This patch, spot, or touch-up painting shall be completed, and shall be dry and hard, before additional paint is applied.

3.5 LATEX PAINT

- A. Latex paint shall be applied by brushing or rolling; spraying is not permitted. Latex paint shall not be thinned excessively.

3.6 MIXING AND THINNING

- A. Paint shall be thoroughly mixed each time any is withdrawn from the container. Paint containers shall be kept tightly closed except while paint is being withdrawn.
- B. Unless otherwise authorized, all paint shall be factory mixed to proper consistency and viscosity for hot weather application without thinning. Thinning will be permitted only as necessary to obtain recommended coverage at lower application temperatures. In no case shall the wet film thickness of applied paint be reduced, by addition of paint thinner or otherwise, below that represented by the recommended coverage rate.

3.7 FILM THICKNESS FOR FERROUS METALS

- A. It is intended that the dry film thickness and the continuity of painted ferrous metal surfaces be subject to continual field check by the Engineer. Dry film thickness shall be measured by the Contractor, using an approved Thickness Gauge, at locations selected by Engineer. Testing equipment provided shall be provided by Contractor and kept on site.
- B. Measurement of Dry Coating Thickness shall conform with paint application Standard SSPC-PA2
- C. Thickness and Holiday Checking - Thickness of coatings and paint shall be checked with a non-destructive, magnetic type thickness gauge.
- D. Holiday Checking of all interior coated surfaces shall be tested with an approved holiday detection device. Non-destructive holiday detectors shall not exceed 100 volts nor shall destructive holiday detectors exceed the voltage recommended by the manufacturer of the coating system. For thicknesses between 10 and 20 mils (0.25mm and 0.50mm) a non-sudsing type wetting agent such as Kodak Photo-Flo, shall be added to the water prior to wetting the detector sponge. All pinholes shall be marked, repaired in accordance with the manufacturer's printed recommendations and re-tested. No pinholes or other irregularities will be permitted

in the final coating. Holiday detection devices shall be operated in the presence of the Engineer.

- E. Continuity shall be tested by a low voltage-wet sponge per RPO 188. Contractor shall perform continuity tests as required by the Engineer on surfaces that will be submerged.

3.8 *ATMOSPHERIC CONDITIONS*

- A. Apply all material to dry and properly prepared surfaces when weather conditions are favorable for painting. No materials shall be applied when the temperature of the materials is below 50 degrees F, or when the temperature of the air, surface to be painted or substrate, is below (or likely to fall below) 50 degrees F. Final ruling on the favorability of weather conditions shall be in accordance with the recommendations of the manufacturer and/or the Engineer.
- B. No coating or paint shall be applied to wet or damp surfaces, in rain, snow, fog, or mist, when the steel temperature or surrounding air temperature is less than 5 degrees above the dew point, nor in conditions not recommended by the manufacturer

3.9 *REPAIRING DAMAGED PAINT ON EQUIPMENT*

- A. Painted surfaces on equipment, which have become damaged prior to acceptance by the Owner, shall be repainted with the same or equivalent paint used in the original application.

3.10 *PROTECTION OF SURFACES*

- A. Throughout the work the Contractor shall use drop cloths, masking tapes, and other suitable measures to protect all surfaces from accidental spraying, splattering, or spilling of paint. Contractor shall be liable for and shall correct and repair any damaged condition resulting from its operations or from the operations of all those who are responsible to the Contractor during the time its work is in progress and until the work is accepted. In case bituminous paints are spilled or dropped on any material except metals, the spots shall, after surface cleaning, be spot painted with aluminum paint prior to applying the specified paint. Any exposed concrete or masonry not specified to be painted which is damaged by paint shall be either removed and rebuilt or, where so authorized by the Owner, painted with two coats of masonry paint.

3.11 *CLEANUP*

- A. All cloths and cotton waste which might constitute a fire hazard shall be placed in metal containers or destroyed at the end of each work day. Upon completion of the work all staging, scaffolding and containers shall be removed from the site or destroyed in a manner approved by the Engineer.

3.12 PAINTING SCHEDULE

<u>SYSTEM</u>	<u>SURFACE</u>	<u>FINISH</u>			
		<u>SURF. PREP.</u>	<u>PRIME COAT</u>	<u>2ND COAT</u>	<u>3RD COAT</u>
1.	New ferrous metal in submerged or damp environment including all submerged mechanical components.	SP-10	P-1	P-1	F-5
2.	All exterior exposed new structural and miscellaneous steel. All exterior exposed surfaces of new piping, pumps, motors, electrical equipment and other unsubmerged mechanical and structural items.	SP-6	P-1	P-1	F-5
3.	All surfaces of new structural and miscellaneous steel pipe, pumps, motors and electrical equipment panels exposed inside building.	SP-6	P-2	F-3	F-3
4.	All interior exposed new galvanized metalwork including electrical conduit inside buildings, including fittings, boxes, supports and accessories.	G-1	P-3	F-3	F-3
5.	All exterior exposed new galvanized metalwork including roof flashings and other architectural items.	G-1	P-3	F-2	F-2
6.	Exposed new PVC piping	V-1	F-5	F-5	

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7.	All new buried valves and flanged joints and other buried miscellaneous ferrous piping and metal surfaces (excluding case iron pipe). All exterior surfaces of new cast iron and steel piping exposed in manholes, wet wells and similar locations, including valves, fittings, flanges, bolts, supports, and accessories. Miscellaneous new castings, including manhole rings and covers and manhole steps. (One coat, if not foundry dipped.)	SP-10	F-4	F-4
8.	Interior wood	P-4	F-2	F-2
9.	Exterior wood	P-4	F-3	F-3
10.	Interior dry wall	P-5	F-6	
11.	Exterior concrete block	P-6	F-7	
12.	Concrete	P-6	F-7	

3.13 When conflicting painting specifications or requirements are encountered in the contract documents, the more restrictive specifications or requirements shall be required.

END OF SECTION

PAINTING AND COATING
09 90 00-13

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SECTION 09 97 61
FUSION-BONDED EPOXY LININGS AND COATINGS

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section includes materials, application, and testing of one-part, fusion-bonded, heat-cured, thermosetting, 100 percent solids epoxy linings and coatings on steel, cast-iron, and ductile-iron equipment, such as valves, flexible pipe couplings, and steel pipe.

1.2 RELATED WORK

- A. Section 09 90 00 – Painting and Coating
- B. Section 40 05 00 – Pipe and Fittings

1.3 SUBMITTALS

- A. Submit shop drawings in accordance with Section 01 33 00 – Submittals.
- B. Submit manufacturer's catalog literature and product data sheets, describing the physical and chemical properties of the epoxy coating. Describe application and curing procedure.
- C. Submit coating application test records for measuring coating thickness and holiday detection for each item or pipe section and fitting. Describe repair procedures used.

PART 2 MATERIALS

2.1 PIPING AND EQUIPMENT SURFACES

- A. The Contractor shall require the equipment suppliers to provide equipment that is free of salts, oil, and grease to the coating applicator.
- B. The Contractor shall require pipe suppliers to provide bare pipe that is free of salts, oil, and grease to the coating applicator.

2.2 SHOP-APPLIED EPOXY LINING AND COATING

- A. Lining and coating shall be a 100 percent solids, thermosetting, fusion-bonded, dry powder epoxy resin: Scotchkote 134 or 206N, Valspar "Pipeclad 1500 Red," or equal. Epoxy lining and coating shall meet or exceed the following requirements:

Hardness (minimum)	Barcol 17 (ASTM D2583) Rockwell 50 ("M" scale)
Abrasion resistance (maximum value)	1,000 cycles: 0.05 gram removed
	5,000 cycles: 0.115 gram removed
	ASTM D1044, Tabor CS 17 wheel, 1,000-gram weight
Adhesion (minimum)	3,000 psi (Elcometer)
Tensile strength	7,300 psi (ASTM D2370)
Penetration	0 mil (ASTM G17)
Adhesion overlap shear, 1/8-inch steel panel, 0.010 glue line	4,300 psi, ASTM D1002
Impact (minimum value)	100 inch-pounds (Gardner 5/8-inch diameter tup)

2.3 FIELD-APPLIED EPOXY COATING FOR PATCHING

- A. Use a minimum 80 percent solids liquid epoxy resin, such as Scotchkote 306 or 323.

2.4 PAINTING AND COATING OF GROOVED-END AND FLEXIBLE PIPE COUPLINGS

- A. Line and coat couplings the same as the pipe. Color shall match the color of the pipe fusion epoxy coating.

PART 3 EXECUTION

3.1 SHOP APPLICATION OF FUSION-BONDED EPOXY LINING AND COATING - GENERAL

- A. Grind surface irregularities, welds, and weld spatter smooth before applying the epoxy. The allowable grind area shall not exceed 0.25 square foot per location, and the maximum total grind area shall not exceed 1 square foot per item or piece of equipment. Do not use any item, pipe, or piece of equipment in which these requirements cannot be met.
- B. Remove surface imperfections, such as slivers, scales, burrs, weld spatter, and gouges. Grind outside sharp corners, such as the outside edges of flanges, to a minimum radius of 1/4 inch.
- C. Uniformly preheat the pipe, item, or piece of equipment prior to blast cleaning to remove moisture from the surface. The preheat shall be sufficient to ensure that the surface temperature is at least 5 degree Fahrenheit above the dew point temperature during blast cleaning and inspection.
- D. Sandblast surfaces per SSPC SP-5. Protect beveled pipe ends from the abrasive blast cleaning.

- E. Apply lining and coating by the electrostatic spray or fluidized bed process. Minimum thickness of lining or coating shall be 15 mils. Heat and cure per the epoxy manufacturer's recommendations. The heat source shall not leave a residue or contaminant on the metal surface. Do not allow oxidation of surfaces to occur prior to coating. Do not permit surfaces to flash rust before coating.

3.2 SHOP APPLICATION OF FUSION-BONDED EPOXY LINING AND COATING TO PIPE- ADDITIONAL REQUIREMENTS

- A. Apply lining and coating per AWWA C213 except as modified herein.
- B. Grind 0.020 inch (minimum) off the weld caps on the pipe weld seams before beginning the surface preparation and heating of the pipe.

3.3 SHOP APPLICATION OF FUSION-BONDED EPOXY LINING AND COATING TO JOINT AREAS OF DUCTILE -IRON AND CAST-IRON FITTINGS - ADDITIONAL REQUIREMENTS

- A. Limit the protective coating thickness in the joints of ductile-iron and cast-iron fittings to maintain a leak-proof joint. However, the coating thickness in the joint area shall not be less than 4 mils.

3.4 QUALITY OF LINING AND COATING APPLICATIONS

- A. The cured lining or coating shall be smooth and glossy, with no graininess or roughness. The lining or coating shall have no blisters, cracks, bubbles, underfilm voids, mechanical damage, discontinuities, or holidays.

3.5 FACTORY TESTING OF COATING - GENERAL

- A. Test linings and coatings with a low-voltage wet sponge holiday detector. Test pipe linings and coatings per AWWA C213, Section 5.3.3. If the number of holidays or pinholes is fewer than one per 20 square feet of coating surface, repair the holidays and pinholes by applying the coating manufacturer's recommended patching compound to each holiday or pinhole and retest. If the number of pinholes and holidays exceeds one per 20 square feet of coating surface, remove the entire lining or coating and recoat the item or pipe.
- B. Measure the coating thickness at three locations on each item or piece of equipment or pipe section using a coating thickness gauge calibrated at least once per eight-hour shift. Record each measured thickness value. Where individual measured thickness values are less than the specified minimum thickness, measure the coating thickness at three additional points around the defective area. The average of these measurements shall exceed the specified minimum thickness value, and no individual thickness value shall be more than 2 mils below or 3 mils above the specified minimum value. If a section of the pipe, item, or piece of equipment does not meet these criteria, remove the entire lining or coating and recoat the entire item or piece of equipment.

3.6 FACTORY INSPECTION OF LINING AND COATING OF PIPE-ADDITIONAL REQUIREMENTS

- A. Check for coating defects on the weld seam centerlines. There shall be no porous blisters, craters, or pimples lying along the peak of the weld crown.

3.7 SHIPPING, STORAGE, AND HANDLING

- A. When loading piping, fittings, couplings, or other coated items for shipment to the project site, use spacers and other protective devices to separate pipes or other coated items to prevent damaging the coated surfaces during transit and unloading. If wood spacers are used, remove wood splinters and particles from the coated surfaces after separation. Use padded chains or ribbon binders to secure the loaded pipe or other coated items and minimize damage.
- B. Do not load or unload pipe, fittings, couplings, or other coated items by inserting forklift tines or lifting chains inside the pipe or item. Use nonmetallic slings, padded chains, or padded forklift tines to lift pipe or other coated items.
- C. Cover piping or other coated items 100 percent with protective coverings or tarpaulins to prevent deposition of road salts, fuel residue, and other contaminants in transit.
- D. Provide stulls, braces, and supports for piping during shipping and storage such that out-of-roundness or deflection does not exceed 0.5 percent of the pipe diameter.
- E. Handle piping and other coated items with care during the unloading, installation, and erection operations to minimize damage. Do not place or store pipe or other coated items on the ground or on top of other work unless ground or work is covered with a protective covering or tarpaulin. Place pipe or other coated items above the ground upon platforms, skids, or other supports.
- F. Store piping or other coated items at the site on pallets to prevent direct contact with ground or floor. Cover pipe or coated items during storage with protective coverings or tarpaulins to prevent deposition of rainwater, salt air, dirt, dust, and other contaminants.
- G. Do not allow piping or other coated items to contact metal, concrete, or other surfaces during storage, handling, or installation and erection at the site that could damage or scratch the coating.

3.8 FIELD REPAIRS

- A. Patch scratches and damaged areas incurred while installing fusion-bonded epoxy coated items with a two-component, 80 percent solids (minimum), liquid epoxy resin. Wire brush or sandblast the damaged areas per SSPC SP-10. Lightly abrade or sandblast the coating or lining on the sides of the damaged area before applying the liquid epoxy coating. Apply an epoxy coating to defective linings and coatings to areas smaller than 20 square inches. Patched areas shall overlap the parent or base coating a minimum of 0.5 inch. If a defective area exceeds 20 square inches, remove

the entire lining and coating and recoat the entire item or piece of equipment. Apply the liquid epoxy coating to a minimum dry-film thickness of 15 mils.

END OF SECTION

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SECTION 11 00 00

GENERAL EQUIPMENT STIPULATIONS

PART 1 GENERAL

1.1 SCOPE

- A. All equipment furnished and installed under this Contract shall conform to the general stipulations set forth in this section except as otherwise specified in other sections.

1.2 RELATED WORK

- A. Section 09 90 00 – Painting and Coating

1.3 COORDINATION

- A. Contractor shall coordinate all details of the equipment with other related parts of the Work, including verification that all structures, piping, wiring, and equipment components are compatible. Contractor shall be responsible for all structural and other alterations in the Work required to accommodate equipment differing in dimensions or other characteristics from that contemplated in the Contract Drawings or Specifications.

1.4 MANUFACTURER'S EXPERIENCE

- A. Unless specifically named in the Specifications, a manufacturer furnishing equipment of the type and size specified shall have been in successful operation for not less than the past five years.

1.5 WORKMANSHIP AND MATERIALS

- A. Contractor shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage, or other failure. Materials shall be suitable for service conditions.
- B. All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practice. Individual parts shall be manufactured to standard sizes and gages so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service at any time prior to delivery, except as required by tests.
- C. Except where otherwise specified, structural and miscellaneous fabricated steel used in equipment shall conform to AISC standards. All structural members shall be designed for shock or vibratory loads. Unless otherwise specified, all steel which will be submerged, all or in part, during normal operation of the equipment shall be at least 1/4 inch thick.

GENERAL EQUIPMENT STIPULATIONS
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1.6 LUBRICATION

- A. Equipment shall be adequately lubricated by systems which require attention no more frequently than weekly during continuous operation. Lubrication systems shall not require attention during start up or shutdown and shall not waste lubricants.
- B. Lubricants, of the type recommended by the equipment manufacturer, shall be provided in sufficient quantity to fill all lubricant reservoirs and to replace all consumption during testing, startup, and operation prior to acceptance of equipment by Owner.
- C. Lubrication facilities shall be convenient and accessible. Oil drains and fill openings shall be easily accessible from the normal operating area or platform. Drains shall allow for convenient collection of waste oil in containers from the normal operating area or platform without removing the unit from its normal installed position.

PART 2 PRODUCTS

2.1 ELECTRIC MOTORS

- A. Unless otherwise specified, motors furnished with equipment shall meet the following requirements:
 - 1. High efficiency motors shall be supplied for the motor driven equipment specified to be furnished in this contract. Certification shall be supplied for each size, speed, and type of motor indicating the guaranteed minimum efficiency at full load and that the efficiency tests were done in accordance with IEEE Standard 112, Test Method B, using accuracy improvement by segregated loss determination including stray load loss improvement as specified in NEMA Standard MG1-12.53a.
 - 2. Designed and applied in accordance with NEMA, ANSI, IEEE, AFBMA, and NEC for the duty service imposed by the driven equipment, such as frequent starting, intermittent overload, high inertia, mounting configuration, or service environment.
 - 3. Rated for continuous duty at 40° C ambient, unless the application is well recognized for intermittent duty service as a standard industry practice.
 - 4. Insulated with Class B, Class F, or Class H insulation and designed for a service factor of 1.00, 1.15, or greater.
 - 5. Three-phase motors used in conjunction with variable speed drives shall have Class F insulation with a Class B temperature rise at rated nameplate horsepower, and 1.15 service factor.
 - 6. When operating at service factor load, maximum observable temperature rise of insulation and motor parts, as determined by resistance or thermometer methods, shall not exceed the NEMA allowable limits for the type of motor, the type of enclosure, and the particular application with regard to continuous or intermittent duty.

GENERAL EQUIPMENT STIPULATIONS

11 00 00-2

7. To ensure long motor life, nameplate horsepower, regardless of service factor, shall be at least 115 percent of the maximum load imposed by the driven equipment.
8. Designed for full voltage starting.
9. Designed to operate from an electrical system that may have a maximum of 5 percent voltage distortion per IEEE Standard 519.
10. Derated, if required, for the altitude at which the equipment is installed.
11. Clamp-type grounding terminal shall be inside motor conduit box.
12. External conduit boxes shall be oversized at least one size larger than NEMA standard.
13. Totally enclosed motors shall have a continuous moisture drain which also excludes insects.
14. Bearings shall be either oil or grease lubricated.
15. Manufacturer's standard motor may be supplied on integrally constructed, packaged assemblies such as appliances, tools, unit heaters, and similar equipment specified by model number, in applications where a redesign of the unit would be required to furnish motors of other than the manufacturer's standard design. However, in all cases, totally enclosed motors are preferred and shall be furnished if offered by the manufacturer as a standard option.
16. Totally enclosed motors shall be furnished on:
 - a. Outdoor equipment.
 - b. Equipment for installation below grade.
 - c. Chemical feeding and chemical handling equipment.
 - d. Equipment operating in wet or dust-laden locations.
17. Drip-proof motors, or totally enclosed motors at the supplier's option, shall be furnished on equipment in indoor, above-grade, clean, and dry locations.
18. Explosion-proof or submersible motors shall be furnished as required by applicable codes, as specified in other sections, or at the supplier's option.
19. Motors shall be rated and constructed as follows:
 - a. Below 1/2 HP.
 - 1) 115 volts, 60 Hz, single phase.
 - 2) Built-in manual-reset thermal protector, or integrally mounted stainless steel enclosed manual motor starter.

GENERAL EQUIPMENT STIPULATIONS
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- b. 1/2 HP and above.
 - 1) 230 volts, 60 Hz, 3 phase, or
 - 2) 460 volts, 60 Hz, 3 phase, as specified on the Drawings
 - 3) Where specified or required by the drawings, motors used on 240 volt systems shall be 230 volts, 60 Hz, 3 phase.

2.2 DRIVE UNITS

- A. The nominal input horsepower rating of each gear or speed reducer shall be at least equal to the nameplate horsepower of the drive motor. Drive units shall be designed for 24-hour continuous service.
 - 1. Gear motors. Unless otherwise specified, the use of gear motors will not be acceptable.
 - 2. Gear Reducers. Each gear reducer shall be a totally enclosed unit with oil or grease lubricated, rolling element, antifriction bearings throughout.
 - 3. Helical, spiral bevel, combination bevel-helical, and worm gear reducers shall have a service factor of at least 1.50 based on the nameplate horsepower of the drive motor. Shaft-mounted and flange-mounted gear reducers shall be rated AGMA Class II. Helical gear reducers shall have a gear strength rating to catalog rating of 1.5. Each gear reducer shall bear an AGMA nameplate.
 - 4. The thermal horsepower rating of each unit shall equal or exceed the nameplate horsepower of the drive motor. During continuous operation, the maximum sump oil temperature shall not rise more than 100° F above the ambient air temperature in the vicinity of the unit and shall not exceed 200°.
 - 5. Each grease lubricated bearing shall be installed in a bearing housing designed to facilitate periodic re-greasing of the bearing by means of a manually operated grease gun. Each bearing housing shall be designed to evenly distribute new grease, to properly dispose of old grease, and to prevent over-greasing of the bearing. The use of permanently sealed, grease lubricated bearings will not be acceptable. An internal or external oil pump and appurtenances shall be provided if required to properly lubricate oil lubricated bearings. A dipstick or sight glass arranged to permit visual inspection of lubricant level shall be provided on each unit.
 - 6. Gear reducers which require the removal of parts or periodic disassembly of the unit for cleaning and manual re-greasing of bearings will not be acceptable.
 - 7. Certification shall be furnished by the gear reducer manufacturer indicating that the intended application of each unit has been reviewed in detail by the manufacturer and that the unit provided is fully compatible with the conditions of installation and service.
 - a. Variable Speed Drives. Each mechanical variable speed drive shall have a service factor of at least 1.75 at maximum speed based on the

GENERAL EQUIPMENT STIPULATIONS

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nameplate horsepower of the drive motor. A spare belt shall be provided with each variable speed drive unit employing a belt for speed change. Unless specifically permitted by the detailed equipment specifications, bracket type mounting will not be acceptable for variable speed drives.

- b. V-Belt Drives. Each V-belt drive shall include a sliding base or other suitable tension adjustment. V-belt drives shall have a service factor of at least 1.6 at maximum speed based on the nameplate horsepower of the drive motor.

2.3 SAFETY GUARDS

- A. All belt or chain drives, fan blades, couplings, and other moving or rotating parts shall be covered on all sides by a safety guard. Safety guards shall be fabricated from 16 USS gage or heavier galvanized or aluminum-clad sheet steel or 1/2 inch mesh galvanized expanded metal. Each guard shall be designed for easy installation and removal. All necessary supports and accessories shall be provided for each guard. Supports and accessories, including bolts, shall be galvanized. All safety guards in outdoor locations shall be designed to prevent the entrance of rain and dripping water.

2.4 ANCHOR BOLTS

- A. Contractor shall furnish suitable anchor bolts for each item of equipment unless otherwise agreed upon with Supplier. Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete is placed. Anchor bolts shall comply with the anchor bolts and expansion anchors section and, unless otherwise specified, shall have a minimum diameter of 3/4 inch.
- B. Unless otherwise indicated or specified, anchor bolts for items of equipment mounted on base plates shall be long enough to permit 1-1/2 inches of grout beneath the base plate and to provide adequate anchorage into structural concrete.

2.5 EQUIPMENT BASES

- A. Unless otherwise indicated or specified, all equipment shall be installed on concrete bases at least six inches high. Cast iron or welded steel base plates shall be provided for pumps, compressors, and other equipment. Each unit and its drive assembly shall be supported on a single base plate of neat design. Base plates shall have pads for anchoring all components and adequate grout holes. Base plates for pumps shall have a means for collecting leakage and a threaded drain connection. Base plates shall be anchored to the concrete base with suitable anchor bolts and the space beneath filled with grout as specified in the grout section.

2.6 SPECIAL TOOLS AND ACCESSORIES

- A. Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance.

Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.

2.7 SHOP PAINTING

- A. All steel and iron surfaces shall be protected by suitable paint or coatings applied in the shop. Surfaces which will be inaccessible after assembly shall be protected for the life of the equipment. Exposed surfaces shall be finished, thoroughly cleaned, and filled as necessary to provide a smooth, uniform base for painting. Electric motors, speed reducers, starters, and other self-contained or enclosed components shall be shop primed or finished with a high-grade, oil-resistant enamel suitable for top coating in the field with an alkyd enamel. Coatings shall be suitable for the environment where the equipment is installed.
- B. Surfaces to be painted after installation shall be prepared for painting as recommended by the paint manufacturer for the intended service, and then shop painted with one or more coats of the specified primer.
 - 1. All shop primers shall be compatible with the paint system specified in Section 09 90 00, Painting and Coating, for the particular item.
- C. Machined, polished, and nonferrous surfaces which are not to be painted shall be coated with rust preventive compound, such as Houghton "Rust Veto", Rust-Oleum "R-9" or Engineer approved equivalent.

PART 3 EXECUTION

3.1 PREPARATION FOR SHIPMENT

- A. All equipment shall be suitably packaged to facilitate handling and protect against damage during transit and storage. All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. All equipment shall be protected from exposure to the elements and shall be kept dry at all times.
- B. Painted surfaces shall be protected against impact, abrasion, discoloration, and other damage. Painted surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of Engineer.
- C. Grease and lubricating oil shall be applied to all bearings and similar items.
- D. Each item of equipment shall be tagged or marked as identified in the delivery schedule or on the Shop Drawings. Complete packing lists and bills of material shall be included with each shipment.

3.2 STORAGE

- A. Upon delivery, all equipment and materials shall immediately be stored and protected until installed in the Work.

- B. Pumps, motors, electrical equipment, and all equipment with antifriction or sleeve bearings shall be stored in weathertight structures maintained at a temperature above 60° F. Equipment, controls, and insulation shall be protected against moisture and water damage. All space heaters furnished in equipment shall be connected and operated continuously.
- C. Equipment and materials shall not show any pitting, rust, decay, or other deleterious effects of storage when installed in the Work.

3.3 *INSTALLATION AND OPERATION*

- A. Equipment shall not be installed or operated except by, or with the guidance of, qualified personnel having the knowledge and experience necessary to obtain proper results. When so specified, or when employees of Contractor or his Subcontractors are not qualified, such personnel shall be field representatives of the manufacturer of the equipment or materials being installed.
- B. Qualified field representatives shall be provided by the equipment manufacturers as required to perform all manufacturer's field services called for in the Specifications. Manufacturer's field representatives shall observe, instruct, guide, and direct Contractor's erection or installation procedures, or perform an installation check, as required. The field representative shall revisit the site as often as necessary to attain installation satisfactory to Engineer.
- C. All equipment installed under this Contract shall be placed into successful operation according to the written instructions of the manufacturer or the instructions of the manufacturer's field representative. All required adjustments, tests, operation checks, and other startup activity shall be provided.
- D. Acceptance of Work in connection with the installation of equipment furnished by others will be subject to approval of the field representative. Contractor shall be responsible for planning, supervising, and executing the installation of Work, and the approval or acceptance of Engineer or the field representative will not relieve Contractor of responsibility for defective Work.

3.4 *OBSERVATION OF PERFORMANCE TESTS*

- A. Where the Specifications require the presence of Engineer, initial tests shall be observed or witnessed by Engineer. Owner shall be reimbursed by Contractor for all costs of subsequent visits by Engineer to witness or observe incomplete tests, retesting, or subsequent tests.

3.5 *WARRANTY*

- A. A written manufacturer's warranty shall be provided for equipment supplied under this contract. The warranty shall be for a minimum of one (1) year or as specified in accordance with other Sections of the contract documents, after the date the equipment is accepted for use by the Owner by filing of the notice of completion, unless otherwise agreed in writing by Owner. The warranty shall cover all defects or failures of materials, design, or workmanship that occur as the result of normal operation and service.

END OF SECTION

GENERAL EQUIPMENT STIPULATIONS
11 00 00-8

SECTION 26 05 00

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under Division 26.

B. Related work under this section

1. Labor and materials required to furnish and install the electrical systems in a complete and operational fashion.
2. Carpentry, masonry, steel and concrete materials and labor required for construction of proper stands, bases and supports for electrical materials and equipment.
3. Cutting and patching of holes required by installation including flashing and counter-flashing of roof and exterior wall penetrations.
4. Excavating, pumping and backfilling required for installation.
5. Repair of damage to the premises resulting from construction activities under this Section to Owner's satisfaction.
6. Removal of work debris from construction activities to Owner's satisfaction.
7. Testing and cleaning of equipment installed.

C. Work not under this section

1. Furnishing of motors, fans, compressors, water heaters, thermostats and motor starters included under Division 23, or as noted otherwise.
2. Furnishing of motors, fans, compressors, water heaters, thermostats and motor starters included under Division 23, or as noted otherwise.
3. Electrical Contractor shall provide connections to mechanical equipment where voltage exceeds 50 V and all necessary raceways for low voltage controls.

D. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and nature of related work and properly coordinate work specified herein with that specified elsewhere to provide a complete and working installation.
 - a. The General Conditions and General Requirements, Division 1, are a part of and are to apply to all the work of this Division.
 - b. Site Construction –Division 31: Earthwork, Boring

- c. Concrete –Division 3: All sections
- d. Metals –Division 5: Structural Metal Framing
- e. Wood and Plastic –Division 6: Rough Carpentry
- f. Thermal and Moisture Protection – Division 7: Dampproofing and Waterproofing, Flashing, Fire and Smoke Protection
- g. Doors and Windows – Division 8: Access Doors
- h. Finishes – Division 9: Painting and Coatings
- i. Equipment – Division 11: As provided
- j. Special Construction – Division 13: As provided
- k. Mechanical –Division 23: Heat-Generation Equipment, Refrigeration Equipment, HVAC Equipment, HVAC Instrumentation and Controls

1.02 REFERENCES

A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. CCR –California Code of Regulations

- a. Title 8 –Industrial Relations; Division 1 –Department of Industrial Relations
 - 1) Chapter 3.2 -California Occupational Safety and Health Regulations (CAL/OSHA)
 - 2) Chapter 4 –Division of Industrial Safety
 - a) Subchapter 4 -Construction Safety Orders (CSO)
 - b) Subchapter 5 -Electrical Safety Orders (ESO)
- b. Title 24 –California Building Standards
 - 1) Part 1 -Building Standards Administrative Code
 - 2) Part 2 -California Building Code (CBC); International Building Code (IBC) with California amendments
 - 3) Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
 - 4) Part 4 -California Mechanical Code (MEC); IAPMO Uniform Mechanical Code (UMC) with California amendments
 - 5) Part 5 -California Plumbing Code; IAPMO Uniform Plumbing Code (UPC) with California amendments
 - 6) Part 6 -California Energy Code
 - 7) Part 7 -California Elevator Safety Construction Code
 - 8) Part 9 -California Fire Code; International Fire Code (IFC) with California amendments
 - 9) Part 12 -California Reference Standards Code

2. CPUC –California Public Utilities Commission
 - a. GO-95; Rules for Overhead Electric Line Construction
 - b. GO-128; Rules for Construction of Underground Electric Supply and Communication Systems
3. IEEE –Institute of Electrical and Electronic Engineers
 - a. C2; National Electrical Safety Code (NESC)
4. NECA –National Electrical Contractors Association
 - a. 1; Standard Practices for Good Workmanship in Electrical Contracting
 - b. 4090; Manual of Labor Units
5. All applicable local municipal codes and ordinances.
6. Applicable rules and regulations of local utility companies.

1.03 SUBMITTALS

A. Product data

1. Prior to commencement of work and within 35 days after award of Contract, submit in ample time for approval in accordance with Division 1 a complete list of furnished equipment, material and shop drawings, including all substitutions. Partial or incomplete lists of materials will not be considered. Substitutions will be considered thereafter.
 - a. Where it is in the best interest of Owner, Engineer may give written consent to a submittal received after expiration of designated time limits or for an additional re-submittal.

B. Closeout submittal

1. Furnish three complete sets of maintenance and operating instructions bound in a binder and indexed to Owner. Start compiling data upon approval of materials and equipment. Final inspection will not be made until Engineer approves binders. Refer also to Division 1 for additional requirements.
2. Provide one of each tool required for proper equipment operation and maintenance provided under this Section. All tools shall be delivered to the Owner at project completion.
3. Provide two keys to Owner for each lock furnished under Division 26.
4. Record drawings
 - a. Upon completion of Work, furnish Engineer with complete sets of plans (not marked blueprints) upon which shall be shown all work installed under Contract, which are not in accordance with the Construction Documents. Refer to Division 1 requirements.
 - b. All symbols and designations used in preparing Record Drawings shall match those used in Construction Documents.

1.04 SUBSTITUTIONS

- A. If it is desired to make a substitution, the Contractor shall clearly identify each substitution on the submittal, and to submit complete information or catalog data to show equality of equipment or material offered to that specified. Substitutions will be interpreted to be all manufacturers other than those specifically listed by model or catalog number within these Specifications and Drawings. No substitution will be allowed unless identified, requested and approved in writing. Materials of equal merit and appearance, in the opinion of the Engineer, will be approved for use. Architect and Engineer reserve the right to require originally specified items at no additional costs to Owner. Only one request for substitutions will be considered on each item of material or equipment.
- B. Acceptance of a substitute is not to be considered a release from the Specifications. Correct any deficiencies in an item, even though approved at the Contractor's expense.
- C. Responsibility for installation of approved substitution is included herein. Make any changes required for installation of approved substituted equipment without additional costs.
- D. Failure to comply with any of the requirements of the above will necessitate that the specified materials be submitted and supplied.

1.05 CHANGE ORDER PROPOSALS

- A. Shall comply with the requirements set forth by the General Conditions
- B. All change order proposals and requests, both additive and deductive, shall be accompanied by a detailed materials and labor breakdown for each specific task and/or item.
 - 1. All change order proposals and change orders, both additive and deductive, shall be based upon and be accompanied by a detailed materials and labor breakdown for each specific task and/or item. The breakdown shall include actual materials costs plus overhead and profit, as well as labor units base upon the most recent NECA Manual of Labor Units (NECA Index #4090) or equivalent publication for each specific task and item. Labor costs shall be computed as outlined within the General Conditions, based upon the NECA labor tables for each task required. Materials costs shall include actual Contractor invoice plus no more than 15% markup. The Owner and Contractor agree to the above change order cost procedure, for both additive and deductive change orders.

1.06 QUALITY ASSURANCE

- A. References to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies shall mean that latest edition of such publications adopted and published prior to bid submittal. Such codes or standards shall be considered a part of this Specification as though fully repeated herein.
- B. Work and materials shall be in full accordance with the latest rules and regulations of applicable state or local laws or regulations and standards of following:
 - 1. National Fire Protection Association (NFPA)

2. California Electrical Code (CEC)
 3. California Occupational Safety Health Act (Cal-OSHA)
 4. California State Fire Marshall (CSFM)
 5. California Code of Regulations (CCR)
 6. Electrical Safety Orders, CAC Title 8 (ESO)
 7. California Public Utilities Commissions, General Order 95 (GO-95)
 8. Applicable rules and regulations of local utility companies.
 9. NECA 1-2000, Standard Practices for Good Workmanship in Electrical Contracting
- C. All electrical equipment and material furnished under Division 26 shall conform to all CEC/NEC requirements and bear the Underwriters' Laboratories (UL) label where applicable.
- D. Nothing in the Construction Documents shall be construed to permit work not conforming to these Codes. Whenever the indicated material, workmanship, arrangement or construction is of high quality or capacity than that required by the above rules and regulations, the Construction Documents shall take precedence. Should there be any direct conflict between the rules and regulations and Construction Documents, the rules shall govern.
- E. All electrical equipment and material furnished under this Section shall conform to NEMA and ASTM standards, NEC/CEC and bear the Underwriters' Laboratories (UL) label where such label is applicable.
- F. All electrical work shall conform to manufacturer's written instruction, and the NECA Standard Practices for Good Workmanship in Electrical Contracting and all published recommended practices at the time of project. The Contractor shall use the requirements within the Specifications whenever they exceed NECA guidelines.
- G. Follow manufacturer's direction where these direction cover points not included with the Construction Documents.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Packing, shipping, handling and unloading
1. Damage to the equipment delivered to the site or in transit to the job shall be the responsibility of the Electrical Contractor.
 2. Equipment and material delivery of shall be scheduled as required for timely, expeditious progress of work.
- B. Storage and protection of job equipment is the responsibility Contractor.
- C. Comply with Division 1 requirements with regards to waste management and disposal.

1.08 PROJECT CONDITIONS

A. Discrepancies

1. In the event of discrepancies with the Contract Documents, Engineer shall be notified with sufficient time as stated within Division 1 to allow the issuing of an addendum prior to the bid opening.
2. If, in the event that time does not permit notification of clarification of discrepancies prior to the bid opening, the following shall apply:
 - a. The drawings govern in matters of quantity and specifications govern in matters of quality.
 - b. In the event of conflict within the drawings and specifications involving quantities or quality, the greater quantity or higher quality shall apply. Such discrepancies shall be noted and clarified within the contractor's bid. No additional allowances will be made because of errors, ambiguities or omissions which reasonably should have been discovered during the bid preparation.

B. Verify all power and communication utilities' requirements prior to commencement of any utility work. Make proper adjustments to the construction to satisfy the serving utility.

C. Information shown relative to services is based upon available records and data, but shall be regarded as approximate only. Make minor deviations found necessary to conform to actual locations and conditions without extra cost. Verify locations and elevations of utilities prior to commencement of excavation for new underground installation.

D. Exercise extreme care in excavating near existing utilities to avoid any damage thereto; be responsible for any damage caused by such operations. Contact all utility companies to obtain exact locations prior to commencement of construction.

E. The electrical plans indicate the general layout and arrangement; the architectural drawings and field conditions shall determine exact locations. Field verify all conditions and modify as required to satisfy design intent. Maintain all required working clearances.

F. Fees, permits and utility services

1. Obtain and pay for all permits and service charges required for the installation of this work. Arrange for required inspections and secure approvals from authorities having jurisdiction. Arrange for all utility connections and pay charges incurred including excess service charges if any.
2. Extra charges imposed by the electrical and communication utility companies shall be included in the bid, if available. Unless otherwise stated, these charges will be assumed to be included in the bid.

G. Provide and maintain temporary construction power. The General Contractor or Owner will pay for electric energy charges; refer to Division 1 for details. Should the Electrical Contractor be the prime contractor, the Electrical Contractor shall pay for energy charges unless negotiated with Owner.

1.09 SEQUENCING

- A. Coordinate work within phasing plans as provided by the Owner.

1.10 WARRANTY

- A. Furnish one-year minimum guarantee in accordance with and in form required under Division 1. Repair or replace as may be necessary any defective work, material, or part without cost to the Owner, include repair or replacement of other work, furnishing, equipment or premises caused by such repair or replacement of defective work.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Materials mentioned herein or on Drawings require that the items be provided and of quality noted or an approved equal. All materials shall be new, full weight, standard in all respects and in first-class condition. Insofar as possible, all materials used shall be of the same brand or manufacturer throughout for each class of material or equipment.
- B. Trade names or catalog numbers stated herein indicate grade or quality of material desired. Materials, where applicable, shall be UL labeled and in accordance with NEMA standards.
- C. Dimensions, sizes and capacities shown are a minimum. Do not make changes without written permission of Engineer

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine Construction Documents and Site; be familiar with types of construction where electrical installation is involved. Note carefully other sections of Specifications with their individual cross-references, standard details, etc.
- B. Any electrical work or materials shown either in Construction Documents, but not mentioned herein, or vice versa, shall be executed the same as if mentioned herein, in a workmanlike manner in accordance with all published NECA Standards of Installation.
- C. Coordinate work with other crafts to avoid conflicts, and check all outlet locations with Architectural and Mechanical drawings and specifications. Make minor adjustments without additional cost to Owner.
- D. Engineer will make clarifications and rulings concerning any obvious discrepancies or omissions in work prior and after bidding. Perform all work involved in correcting obvious errors or omissions after award of contract as directed by Engineer at Contractor's expense.

- E. Examine site dimensions and locations against Drawings and become informed of all conditions under which work is to be done before submitting proposals. No allowance will be made for extra expense due to error.
- F. Layouts of equipment, accessories and wiring systems are diagrammatic (not pictorial), but shall be followed as closely as possible. Construction Documents are for assistance and guidance, and exact locations, distance, levels, etc., will be governed by construction; accept same with this understanding.
- G. Horsepower of motors or wattage of equipment indicated in Construction Documents is estimated horsepower or wattage requirement of equipment furnished under other sections of Specifications. Size all feeders (conduit and wiring), motor starters, overload protection and circuit breakers to suit horsepower of motors or wattage of equipment actually furnished under various sections of specifications. However, in no case shall feeders and branch circuits (conduit and wiring) and circuit breakers be of smaller capacities or sizes than those indicated on Drawings or specified, unless approved in writing by Engineer.

3.02 PREPARATION

- A. Seal all exterior wall penetrations in an approved watertight manner and to the satisfaction of Engineer and Architect.
- B. Channels, joiners, hangers, caps, nuts and bolts and associated parts shall be plated electrolytically with zinc followed immediately thereafter by treating freshly deposited zinc surfaces with chromic acid to obtain a surface which will not form a white deposit on surface for an average of 120 hours when subjected to a standard salt spray cabinet test, or shall be hot dipped galvanized

3.03 INSTALLATION

- A. Equipment identification
 - 1. Properly identify panelboards, remote control switches, push buttons, terminal boxes, etc. with a descriptive nameplate. Make nameplate with 3/32" laminated plastic with black background and white letters. Machine engraved letters 1/8" high for equipment in device box(es) and 1/4" high for panelboards, terminal cabinets or larger items. Punched strip type nameplates and cardholders in any form are not acceptable. Fasten nameplates with oval head machine screws, tapped into front cover/panel.
- B. Working spaces
 - 1. Provide adequate working space around electrical equipment in compliance with Article 4 of Electrical Safety Orders and CEC/NEC 110.26. In general provide 78" of headroom and 30" wide minimum clear workspace in front of panelboards and controls. In addition to the above, provide the following minimum working clearances:
 - a. 0V – 150V (line-to-ground) provide 36" minimum clear distance.
 - b. 151V – 600V (line-to-ground) provide 42" minimum clear distance.

C. Equipment supports

1. Anchor all electrical equipment to structure. Support systems shall be adequate to withstand seismic forces per CBC.

D. Excavating and backfilling

1. Excavate and backfill as required for installation of Work. Restore all surfaces, roadways, walks, curbs, walls existing underground installations, etc., cut by installations to original condition in an acceptable manner. Maintain all warning signs, barricades, flares and lanterns as required by ESO and local ordinances.
2. Dig trenches straight and true to line and grade, with bottom clear of any rock points. Support conduit for entire length on undisturbed original earth. Minimum conduit depth of pipe crown shall be 24" below finished or natural grade, unless otherwise noted.

E. Forming, cutting and patching

1. In new construction, General Contractor shall provide any special forming, recesses, chased, etc., and provide wood blocking, backing and grounds as necessary for the proper installation of electrical work. Be responsible for notifying General Contractor that such provision is necessary; layout work and check to see that it suits his requirements.
 - a. Provide metal backing plates, anchor plates and such that are required for anchorage of electrical work under Division 26; securely weld or bolt to metal framing. Wood blocking or backing will not be permitted in combination with metal framing.
2. Be responsible for proper placement of pipe sleeves, hangers, inserts and supports for this Work.

F. Concrete work

1. Provide concrete work related solely to electrical work. Concrete work, including forming and reinforcing steel installed for all electrical work, shall comply with all applicable requirements of Division 3, or in accordance with the State of California Standard Specifications issued by the Department of Transportation (CALTRANS).

3.04 REPAIR/RESTORATION

- A. Cutting, patching and repairing of existing construction to permit installation of work under Division 26 is the responsibility of Contractor. Repair or replace all damage to existing work in kind to Owner's satisfaction.
- B. Obtain Engineer's approval prior to performing any cutting or patching of concrete, masonry, wood or steel structure within building.

3.05 FIELD QUALITY CONTROL

A. Inspection of work

1. Working parts shall be readily accessible for inspection, repair and renewal. The right is reserved to make reasonable changes in equipment location shown on Drawings prior to rough in without additional costs to the Owner.

2. During construction all work will be subject to observation by the Engineer and his representatives. Assist in ascertaining any information that maybe required.
 3. Do not allow or cause any work installed hereunder to be covered up or enclosed before it has been inspected and approved. Should any work be enclosed or covered prior to approval, uncover work, and after it has been inspected and approved, restore work of all others to the condition in which it was found at the time of cutting, all without additional costs to Owner.
- B. Furnish all testing equipment as maybe required.
- C. Test all wiring and connections for continuity and grounds; where such tests indicate faulty insulation or other defects, locate, repair and re-test.
- D. Check rotation of all motors and correct if necessary.

3.06 CLEANING

- A. Repair or replace all broken, damaged or otherwise defective parts without additional cost to Owner, and leave entire work in a condition satisfactory to Engineer. At completion, carefully clean and adjust all equipment, fixtures and trim installed as part of this work; leave systems and equipment in satisfactory operating condition.
- B. Clean out and remove from the site all surplus materials and debris resulting from this work; this includes surplus excavated materials.

3.07 DEMONSTRATION

- A. At project completion, Contractor shall allot a period of not less than 8 hours for instruction of operating and maintenance personnel in the use of all systems installed under this Section. This time is in addition to any instruction time stated in the Specifications of other sections for other equipment (i.e., fire alarm, security, intercom, etc.). All personnel shall be instructed at one time, the Contractor shall make all necessary arrangements with manufacturer's representatives as may be required. Contractor, if any, for the above services shall pay all costs.

3.08 PROTECTION

- A. In performance of work, protect work of other trades as well as work under this Section from damage.
- B. Protect electrical equipment, stored and installed, from dust, water or other damage.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes

1. Provide all labor, materials and equipment necessary for the installation of all conductors and cables under this Section related to lighting, power, mechanical, control, and signal systems.

B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.02 REFERENCES

A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. ASTM -American Society for Testing and Materials
 - a. B3; Standard Specification for Soft or Annealed Copper Wire
 - b. B8; Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
 - c. B787/B787M; Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation
 - d. D1000; Standard Test Method for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications
2. CCR –California Code of Regulations, Title 24
 - a. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
3. UL -Underwriters Laboratories, Inc.
 - a. UL 83; Thermoplastic-Insulated Wire and Cables
 - b. UL 486A 486B; Wire Connectors
 - c. UL 486C; Splicing Wire Connectors
 - d. UL 486D; Standard for Insulated Wire Connector Systems for Underground Use or In Damp or Wet Locations
 - e. UL 486E; Standard for Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors

- f. UL 493; Thermoplastic-Insulated Underground Feeders and Branch Circuit Cables
 - g. UL 510; Standard for Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
 - h. UL 854; Service-Entrance Cables
- 4. NEMA –National Electrical Manufacturer’s Association
 - a. WC 70-1999; Nonshielded Power Cables Rated 2000 Volts or less for the Distribution of Electrical Energy
- 5. IEEE –Institute of Electrical and Electronic Engineers
 - a. 82; Standard Test Procedure for Impulse Voltage Tests on Insulated Conductors

1.03 SUBMITTALS

- A. Submit manufacturer’s data for equipment and materials specified within this Section in accordance to Section 26 05 00.

1.04 DELIVERY

- A. Wire shall be in original unbroken package. Obtain approval of Inspector or Engineer before installation of wires.

PART 2 - PRODUCTS

2.01 BUILDING WIRE

- A. Conductor material
 - 1. Provide annealed copper for all wire, conductor and cable of not less than 98% conductivity.
 - 2. Wire #8 AWG and larger shall be stranded.
 - 3. Wire #10 AWG and smaller shall be solid.
- B. Insulation material
 - 1. All insulated wire, conductor and cable shall be 600 Vac rated.
 - 2. Feeder and branch circuits larger than #6 AWG shall be type THW, XHHW or THHN/THWN.
 - 3. Feeder and branch circuits #6 AWG and smaller shall be type TW, THW, XHHW or THHN/THWN.
 - 4. Control circuits shall be type THW or THHN/THWN.
 - 5. Wires shall bear the UL label, be color-coded and marked with gauge, type and manufacturer’s name on 24” centers.

2.02 FLEXIBLE CORDS AND CABLES

- A. Provide flexible cords and cables of size, type and arrangement as indicated on Drawings.
- B. Type S flexible cords and cable shall be manufactured in accordance with NEC Article 400 and composed of two or more conductors and a full sized green insulated grounding conductor with an outer rubber or neoprene jacket.
- C. Flexible cords and cables shall be fitted with wire mesh strain relief grips either as an integral connector component or an independently supported unit.
- D. Suspended flexible cords and cables shall incorporate safety spring(s).

2.03 WIRE CONNECTIONS AND TERMINATIONS

- A. Electrical spring wire connectors
 - 1. Provide multi-part construction incorporating a non-restricted, zinc coated square cross-sectional steel spring enclosed in a steel sheet with an outer jacket of plastic and insulating skirt.
 - 2. Self-striping pigtail and tap U-contact connectors are not acceptable.
- B. Compression type terminating lugs
 - 1. Provide tin-plated copper high compression type lugs for installation with hand or hydraulic crimping tools as directed by manufacturer. Notch or single point type crimps are not acceptable.
 - 2. Two hole, long barrel lugs shall be provided for size #4/O AWG and larger wire where terminated to bus bars. Use minimum of three crimps per lug where possible.
- C. Splicing and insulating tape
 - 1. Provide black, UV resistant, self extinguishing, 7 mil thick vinyl general purpose electrical tape per UL 510 and ASTM D1000. 3M Scotch 33 or equal.
- D. Insulating putty
 - 1. Provide pads or rolls of non-corrosive, self-fusing, 125 mil thick rubber putty with PVC backing sheet per UL 510 and ASTM D1000. 3M Scotchfil or equal.
- E. Insulating resin
 - 1. Provide two-part liquid epoxy resin with resin and catalyst in pre-measured, sealed mixing pouch. 3M Scotchcast 4 or equal.
 - 2. Use resin with thermal and dielectric properties equal to the cable's insulating properties.
- F. Terminal strips
 - 1. Provide box type terminal strips in the required quantities plus 25% spare. Install in continuous rows.
 - 2. Use the box type terminal strips with barrier open backs and with ampere ratings as required.
 - 3. Identify all terminals strips and circuits.

G. Crimp type connectors

1. Provide insulated fork or ring crimp terminals with tinned electrolytic copper-brazed barrel with funnel wire entry and insulation support.
2. Fasten crimp type connectors or terminals using a crimping tool recommended by the manufacturer.
3. Provide insulated overlap splices with tinned seamless electrolytic copper-brazed barrel with funnel wire entry and insulation support.
4. Provide insulated butt splices with tinned seamless electrolytic copper-brazed barrel with center stop, funnel wire entry and insulation support.

H. Cable ties

1. Provide harnessing and point-to-point wire bundling with nylon cable ties. Install using tool supplied by manufacturer as required.

I. Wire lubricating compound

1. UL listed for the wire insulation and conduit type, and shall not harden or become adhesive.
2. Shall not be used on wire for isolated type electrical power systems.

J. Bolt termination hardware

1. Bolts shall be plated, medium carbon steel heat-treated, quenched and tempered equal to ASTM A-325 or SAE Grade 5; or silicon bronze alloy ASTM B-9954 Type B.
2. Nuts shall be heavy semi-finished hexagon, conforming to ANSI B18.2.2, threads to be unified coarse series (UNC), class 2B steel or silicon bronze alloy.
3. Flat washers shall be steel or silicon bronze, Type A plain standard wide series, conforming to ANSI B27.2. SAE or narrow series shall be used.
4. Belleville conical spring washers shall be hardened steel, cadmium plated or silicon bronze.
5. Each bolt connecting lug(s) to a terminal or bus shall not carry current exceeding the following values:
 - a. 1/4" bolt – 125 A
 - b. 5/16" bolt – 175 A
 - c. 3/8" bolt – 225 A
 - d. 1/2" bolt – 300 A
 - e. 5/8" bolt – 375 A
 - f. 3/4" bolt – 450 A

PART 3 -EXECUTION

3.01 EXAMINATION

- A. Thoroughly examine site conditions for acceptance of wire and cable installation to verify conformance with manufacturer and specification tolerances. Do not commence with work until all conditions are made satisfactory.

3.02 INSTALLATION

- A. All wire, conductor, and cable with their respective connectors, fittings and supports shall be UL listed for the installed application and ambient conditions.
- B. Feeders and branch circuits in wet locations shall be rated 75°C minimum.
- C. Feeders and branch circuits in dry locations shall be rated 90°C minimum.
- D. Minimum conductor size
 - 1. #12 AWG copper for all power and lighting branch circuits.
 - 2. #14 AWG copper for all line voltage signal and control wiring, unless otherwise indicated.
 - 3. Aluminum conductors may be substituted on the basis of equal performance for sizes greater than #10 AWG with the approval of Engineer.
- E. Remove and replace conductors under the following conditions at no additional costs to the Owner:
 - 1. Installed within wrong specified conduit or raceway.
 - 2. Damaged during installation.
 - 3. Of insufficient length to facilitate proper splice of conductors

3.03 WIRING METHODS

- A. Install wires and cable in accordance with manufacturer's written instructions, as shown on Drawings and as specified herein.
- B. Install all single conductors within raceway system, unless otherwise indicated.
- C. Parallel circuit conductors and terminations shall be equal in length and identical in all aspects.
- D. Provide adequate length of conductors within electrical enclosures and neatly train to termination points with no excess. Terminate such that there is no bare conductor at the terminal.
- E. Splice cables and wires only in junction boxes, outlet boxes, pull boxes, manholes or handholes.
- F. Group and bundle with tie wrap each neutral with its associated phase conductors where more than one neutral conductor is present within a conduit.
- G. Install cable supports for all vertical feeders in accordance with NEC Article 300. Provide split wedge type fittings, which firmly clamp each individual cable and tighten due to cable weight.
- H. Seal cable where exiting a conduit from an exterior underground raceway with a non-hardening compound (i.e., duct seal or equal).
- I. Provide UL listed factory fabricated, solder-less metal connectors of size, ampacity rating, material, type and class for applications and for services indicated. Use connectors with temperature ratings equal or greater than the conductor or cable being terminated.

- J. Stranded wire shall be terminated using fittings, lugs or devices listed for the application. Under no circumstances shall stranded wire be terminated solely by wrapping it around a screw or bolt.
- K. Flexible cords and cables supplied as part of a pre-manufactured assembly shall be installed according to manufacturer's published instructions.

3.04 WIRING INSTALLATION IN RACEWAYS

- A. Install wire in raceway after interior of building has been physically protected from weather, and all mechanical work likely to injure conductors has been completed.
- B. Pull all conductors into raceway at the same time.
- C. Use UL listed, non-petroleum base and insulating type pulling compound as needed.
- D. Completely mandrel all underground or concrete encased conduits prior to installation.
- E. Completely and thoroughly swab raceway system prior to installation
- F. Do not use block and tackle, power driven winch or other mechanical means for pulling conductors smaller than #1 AWG.
- G. Wire pulling
 - 1. Provide installation equipment that will prevent cutting or abrasion of insulation during installation.
 - 2. Maximum pull tension shall not exceed manufacturer's recommended value during installation for cable being measured with tension dynamometer.
 - 3. Use rope made of non-metallic material for pulling.
 - 4. Attach pulling lines by means of either woven basket grips or pulling eyes attached directly to the conductors.
 - 5. Pull multiple conductors simultaneously within same conduit.

3.05 WIRE SPLICES, JOINTS AND TERMINATIONS

- A. Join and terminate wire, conductors and cables in accordance with UL 486, NEC and manufacturer's instructions.
- B. Thoroughly clean wires before installing lugs and connectors.
- C. Make splices, taps and terminations to carry full conductor ampacity without perceptible temperature rise, and shall be made mechanically and electrically secure.
- D. Terminate wires in terminal cabinets using terminal strips, unless otherwise indicated.
- E. Insulate spare conductors with electrical tape and leave sufficient length to terminate anywhere within panel or cabinet.
- F. Encapsulate splices in wet locations using specified insulating resin kits.
- G. Make up all splices and taps in accessible junction or outlet boxes with connectors as specified herein. Pigtails and taps shall be the same color as feed conductor with at least 6 inches of tail, all neatly packed within box.

- H. Where conductors are to be connected to metallic surfaces, coated surfaces shall be cleaned to base metal surface before installing connector. Remove lacquer coating of conduits where ground clamps are to be installed.
- I. Branch circuits (#10 AWG and smaller) connectors shall comply with 2.01.D.2 and 2.01.D.2 above.
- J. Branch circuits (#8 AWG and larger)
 - 1. Join or tap conductors using insulated mechanical compression taps with pre-molded, snap-on insulating boots or specified conformable insulating pad and over-wrapped with two half-lapped layers of vinyl insulating tape starting and ending at the middle of joint.
 - 2. Terminate conductors using mechanical compression lugs in accordance with manufacturer's recommendation or as specified elsewhere.
 - 3. Field installed compression connectors for 250 MCM and larger shall have not less than two clamping elements or compression indents per wire.
 - 4. Insulate splices and joints with materials approved for the particular use, location, voltage and temperature.
- K. Termination hardware assemblies
 - 1. Al/Cu lugs connected to aluminum plated or copper bus shall be secured with steel bolt, flat washer (two per bolt), Belleville washer and nut.
 - 2. Copper lugs connected to copper buss shall bus shall be secured using silicon bronze alloy bolt, flat washer (two per bolt), Belleville washer and nut.
 - 3. The crown of Belleville washers shall be under the nut.
 - 4. Bolt assemblies shall be torque to manufacturer's recommendations. Where manufacturer recommendation is not obtainable, the following shall be used:
 - a. 1/4" -20 bolt at 80 inch-pound torque
 - b. 5/16" -18 bolt at 180 inch-pound torque
 - c. 3/8" -20 bolt at 20 inch-pound torque
 - d. 1/2" -20 bolt at 40 inch-pound torque
 - e. 5/8" -20 bolt at 55 inch-pound torque
 - f. 3/4" -20 bolt at 158 inch-pound torque

3.06 IDENTIFICATION

- A. Securely tag all branch circuits. Mark conductors with specified vinyl wrap-around markers. Where more than two conductors run through a single outlet, mark each conductor with the corresponding circuit number.
- B. Provide all terminal strips with each individual terminal identified using specified vinyl markers.
- C. In manholes, pullboxes and handholes provide tags of embossed brass type with cable type and voltage rating. Attach tags to cable with slip-free plastic cable lacing units.

D. Color coding

1. For 120/208 Volt (or 120/240 Volt), 1 phase, 3 wire systems:
 - a. Phase A – Black
 - b. Phase B – Red
 - c. Neutral – White
 - d. Ground – Green
2. For 120/208 Volt, 3 phase, 4 wire systems:
 - a. Phase A – Black
 - b. Phase B – Red
 - c. Phase C – Blue
 - d. Neutral – White
 - e. Ground – Green
3. For 277/480 Volt, 3 phase, 4 wire systems:
 - a. Phase A – Brown
 - b. Phase B – Orange
 - c. Phase C – Yellow
 - d. Neutral – Gray
 - e. Ground – Green
4. Switch leg individually installed shall be the same color as the branch circuit to which they originate, unless otherwise indicated.
5. Travelers for 3-way and 4-way switches shall be a distinct color and pulled with the circuit switch leg or neutral.

3.07 FIELD QUALITY CONTROL

- A. Supply labor, materials and test equipment required to perform continuity and ground tests.
- B. Electrical testing
 1. Perform feeder and branch circuit insulation test after installation and prior to connection to device.
 2. Tests shall be performed by 600 Vdc megger for a continuous 10 seconds from phase-to-phase and phase-to-ground.
 3. Torque test conductor connections and terminations for conformance to Specifications.
 4. If any failure is detected, locate failure, determine cause and replace or repair cable to Engineer's satisfaction at no additional costs.
 5. Furnish test results in type written report form for review by Engineer.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the item specified under this Section, including but not limited to power system grounding

B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.02 REFERENCES

A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. CCR –California Code of Regulations, Title 24
 - a. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
2. IEEE –Institute of Electrical and Electronic Engineers
 - a. 142; Recommend Practices for Grounding of Industrial and Commercial Power Systems
3. NFPA –National Fire Protection Association
 - a. 780; Lightning Protection Code
4. UL –Underwriters Laboratories, Inc.
 - a. 467; Grounding and Bonding Equipment

1.03 SYSTEM DESCRIPTION

- A. This Section provides for the grounding and bonding of all electrical and communication apparatus, machinery, appliances, components, fittings and accessories where required to provide a permanent, continuous, low impedance, grounded electrical system.**
- B. Ground the electrical service system neutral at service entrance equipment as shown on the Drawings.**

- C. Ground each separately derived system, as defined in CEC/NEC 250-5(d) and on the Drawings, unless specifically noted otherwise.
- D. Except as otherwise indicated, the complete electrical installation including the neutral conductor, equipment and metallic raceways, boxes and cabinets shall be completely and effectively grounded in accordance with all CEC/NEC requirements, whether or not such connections are specifically shown or specified.

1.04 SUBMITTALS

- A. Submit manufacturer's data for equipment and materials specified within this Section in accordance to Section 26 05 00.

1.05 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

PART 2 - PRODUCTS

2.01 CONCRETE ENCASED GROUNDING ELECTRODE (UFER GROUND)

- A. #3/O AWG minimum bare stranded copper conductor.

2.02 DRIVEN (GROUND) RODS

- A. Copper clad steel, minimum $\frac{3}{4}$ " diameter by 10'-0" length, sectional type with copper alloy couplings and carbon steel driving stud; Weaver, Cadweld or equal.

2.03 INSULATED GROUNDING BUSHINGS

- A. Plated malleable iron body with 150°C molded plastic insulated throat and lay-in ground lug; OZ/Gedney BLG, Thomas & Betts #TIGB series or equal.

2.04 CONNECTION TO PIPE

- A. Cable to pipe connections; OZ/Gedney G-100B series, Thomas & Betts #290X series or equal.

2.05 CONNECTIONS TO STRUCTURAL STEEL, GROUND RODS OR SPICES

- A. Where required by the Drawings, grounding conductors shall be spliced together, connected to ground rods or connected to structural steel using exothermic welds, Cadweld or equal, or high pressure compression type connectors, Cadweld, Thomas & Betts or equal.

2.06 BONDING JUMPERS

- A. OZ/Gedney Type BJ, Thomas & Betts #3840 series or equal.

2.07 GROUND CONDUCTOR

- A. Ground conductor shall be code size UL labeled, Type THWN insulated copper wire, green in color.

PART 3 -EXECUTION

3.01 INSTALLATION

A. Grounding electrodes

1. Concrete encased grounding electrode (Ufer ground)

- a. Provide a #3/O AWG minimum bare copper conductor encased along the bottom of concrete foundation, footing or trench which is in direct contact with the earth and where there is no impervious waterproofing membrane between the footing and soil. The electrode shall extend through a horizontal length of 30' minimum and shall be encased in not less than 2" or more than 5" of concrete separating it from surrounding soil. The electrode shall emerge from the concrete slab through a protective non-metallic sleeve and shall be extended to BGB or as shown on Drawings.

2. Supplementary grounding electrode (ground ring, grid and driven rod)

- a. Provide as shown driven ground rod(s). Interconnect ground rod with structural steel and adjacent rods with code size bare copper conductor. Ground rods shall be space no less than 6'-0" on centers from any other electrode or electrodes of another electrical system.

3. Separately derived electrical system grounding electrode

- a. Ground each separately derived system per CEC/NEC 250-26 or as shown on Drawings, whichever is greater.

4. Metal underground water pipe

- a. Contractor shall install an accessible grounding electrode conductor from the main incoming cold water line to BGB. The electrode conductor shall be sized per CEC/NEC Table 250-94 or as shown on Drawings, whichever is greater.

B. Grounding electrode conductor

1. Provide grounding electrode conductors per CEC/NEC Table 250-94 or as shown on Drawings, whichever is greater.

C. Power system grounding

1. Connect the following items using code size copper grounding conductors to BGB or as shown on Drawings:

- a. Concrete encased electrode (Ufer ground)
- b. Ground rod(s)
- c. Incoming cold and fire water pipes
- d. Gas pipe
- e. Structural steel
- f. Distribution transformer secondary

D. Equipment Bonding/Grounding

1. Provide a code sized copper ground conductor, whether indicated or noted on the drawings, in each of the following:
 - a. All power distribution conduits and ducts
 - b. Distribution feeders
 - c. Motor and equipment branch circuits\
 - d. Device branch circuits
2. Provide a separate grounding bus at distribution panelboards, loadcenters, switchboards and motor control centers. Connect all metallic enclosed equipment so that with maximum fault current flowing, shall be maintained at not more than 35V above ground.
3. Metallic conduits terminating in concentric, eccentric or oversized knockouts at panelboards, cabinets, gutters, etc. shall have grounding bushings and bonding jumpers installed interconnecting all such conduits.
4. Provide bonding jumpers across expansion and deflection coupling in conduit runs, pipe connections to water meters and metallic cold water dielectric couplings.
5. Provide ground wire in flexible conduit connected at each end via grounding bushing.
6. Provide bonding jumpers across all cable tray joints.
7. Bond each end of metallic conduit longer than 36" in length to grounding conductor using a #6 AWG pigtail.

3.02 FIELD QUALITY CONTROL

- A. Contractor using test equipment expressly designed for that purpose shall perform all ground resistance tests in conformance with IEEE guidelines. Contractor shall submit typewritten records of measured resistance values to Engineer for review and approval prior to energizing the system.
- B. Obtain and record ground resistance measurements both from electrical equipment ground bus to the ground electrode and from the ground electrode to earth. Furnish and install additional bonding and add grounding electrodes as required to comply with the following resistance limits:
 1. Resistance from ground bus to ground electrode and to earth shall not exceed 5 ohms unless otherwise noted.
 2. Resistance from the farthest panelboard, loadcenter, switchboard or motor control center ground bus to the ground electrode and to earth shall not exceed 20 ohms maximum.
- C. Inspection
 1. The Engineer or Inspector prior to encasement, burial or concealment thereto shall review the grounding electrode and connections.

END OF SECTION

SECTION 26 05 33

RACEWAYS AND BOXES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to electrical conduits; outlet, junction and pull boxes; and related supports.

B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
 - a. 26 05 26 – Grounding and Bonding for Electrical Systems
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.02 REFERENCES

A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. ANSI –American National Standards Institute
 - a. C33.91; Specification for Rigid PVC Conduit
 - b. C80.1; Specification Rigid Steel Conduit, Zinc-Coated
 - c. C80.3; Specification for Electrical Metallic Tubing, Zinc-Coated
 - d. C80.6; Intermediate Metal Conduit (IMC), Zinc-Coated
2. CCR –California Code of Regulations, Title 24
 - a. Part 2 -California Building Code (CBC); International Building Code (IBC) with California amendments
 - b. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
3. NECA –National Electrical Contractors Association
 - a. 101, Standard for Installing Steel Conduit (Rigid, IMC, EMT)
 - b. 111, Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC) (ANSI)
4. NEMA –National Electrical Manufacturer's Association
 - a. FB 1; Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable

- b. FB 2.10; Selection and Installation Guidelines for Fittings for Use with Non-flexible Electrical Metal Conduit or Tubing (Rigid Metal Conduit, Intermediate Metal Conduit, and Electrical Metallic Tubing)
 - c. FB 2.20; Selection and Installation Guidelines for Fittings for Use with Flexible Electrical Conduit and Cable
 - d. OS 1; Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
 - e. OS 3; Selection and Installation Guidelines for Electrical Outlet Boxes
 - f. RN 1; Polyvinyl-Chloride Externally Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing
 - g. TC 2; Electrical Plastic Tubing and Conduit
 - h. TC 3; PVC Fittings for Use with Rigid PVC Conduit and Tubing
 - i. TC 14; Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
5. OSHPD Anchorage Pre-approvals
- a. OPA-0003; Superstrut Seismic Restraint System
 - b. OPA-0114; B-Line Seismic Restraints
 - c. OPA-0120; Unistrut Seismic Bracing System
 - d. OPA-0242; Power-Strut Seismic Bracing System
6. UL –Underwriter’s Laboratories, Inc.
- a. 1; Standard for Flexible Metal Conduit
 - b. 6; Rigid Metal Electrical Conduit
 - c. 360; Standard for Liquid-Tight Flexible Steel Conduit
 - d. 514A; Metallic Outlet Boxes, Electrical
 - e. 514B; Fittings for Conduit and Outlet Boxes
 - f. 651; Schedule 40 & 80 PVC Conduit
 - g. 797; Electrical Metallic Tubing
 - h. 1242; Intermediate Metal Conduit
 - i. 1684; Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
- 1.03 SYSTEM DESCRIPTION
- A. Furnish, assemble, erect, install, connect and test all electrical conduits and related raceway apparatus required and specified to form a complete installation.
- 1.04 SUBMITTALS
- A. Submit manufacturer’s data for materials specified within this Section in accordance to Section 26 05 00.
- 1.05 QUALITY ASSURANCE
- A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

- B. Installation shall conform to the NECA installation guidelines unless otherwise indicated within this Section

PART 2 - PRODUCTS

2.01 MATERIALS

A. Conduits and Fittings

1. Rigid steel conduit (RMC)

- a. Conduit: Standard weight, mild steel pipe, and zinc coated on both inside and outside by a hot dipping or shearardizing process manufactured in accordance with UL 6 and ANSI C80.1 specifications.
- b. Fittings (couplings, elbows, bends, etc.)
 - 1) Shall be steel or malleable iron.
 - 2) Coupling and unions shall be threaded type, assembled with anti-corrosion, conductive and anti-seize compound at joints made absolutely tight to exclude water.
- c. Bushings
 - 1) Insulating bushings: Threaded polypropylene or thermosetting phenolic rated at 150°C minimum.
 - 2) Insulating grounding bushing: Threaded cast body with insulating throat and steel "lay-in" ground lug.
 - 3) Insulating metallic bushing: Threaded cast body with plastic insulated throat rated at 150°C minimum.

2. Coated rigid steel conduit (CRMC)

- a. Conduit: Equivalent to RMC with a Polyvinyl chloride (PVC) coated bonded to the galvanized outer surface of the conduit. The bonding between the PVC coating and conduit surface shall be ETL PVC-001 compliant. The coating thickness shall be a minimum of 40mil.
- b. Fittings (couplings, elbows, bends, etc.)
 - 1) Equivalent to RMC above with bonded coating same as conduit.
 - 2) The PVC sleeve over fittings shall extend beyond hub or coupling approximately one diameter or 1 1/2" whichever is smaller.
- c. Bushing equivalent to RMC above.

3. Intermediate metallic conduit(IMC)

- a. Conduit: Intermediate weight, mild steel pipe, meeting the same requirements for finish and material as rigid steel conduit manufactured in accordance with UL 1242 and ANSI C80.6 specifications
- b. Fittings (couplings, elbows, bends, etc.) equivalent to RMC above.
- c. Bushing equivalent to RMC above.

4. Electrical metallic tubing (EMT)
 - a. Conduit: Cold rolled steel tubing with zinc coating on outside and protective enamel on inside manufactured in accordance with UL 797 and ANSI C80.3 specifications.
 - b. Couplings: Steel or malleable iron with compression type fastener via a nut.
 - c. Connectors: Steel or malleable iron with compression type fastener via a nut with plastic insulated throat rated at 150°C minimum.
5. Rigid non-metallic conduit (PVC)
 - a. Conduit: PVC composed Schedule 40, 90°C manufactured in accordance with NEMA TC 2 and UL 651 specifications.
 - b. Fittings: Molded PVC, slip on solvent welded type in accordance to NEMA TC 3.
6. Reinforced thermosetting resin conduit (RTRC)
 - a. Conduit: Fiber impregnated with a cured thermosetting resin compound in accordance with NEMA TC 14 and UL1684.
 - b. Fittings: Molded resin with glass reinforcement manufactured in the same process as the conduit bonded with an epoxy adhesive.
7. Flexible metallic conduit (FMC)
 - a. Conduit: Continuous, flexible steel spirally wound with zinc coating on both inside and outside in accordance with UL 1.
 - b. Connectors: Steel or malleable iron with compression type fastener via a nut with plastic insulated throat rated at 150°C minimum.
8. Liquidtight flexible metallic conduit (LFMC)
 - a. Conduit: PVC coated, continuous, flexible steel spirally wound with zinc coating on both inside and outside in accordance with UL 360.
 - b. Connectors: Steel or malleable iron with compression type fastener via a nut with plastic insulated throat rated at 150°C minimum.
9. Miscellaneous Fittings and Products
 - a. Conduit sealing bushings: Steel or cast malleable iron body and pressure clamps with PVC sleeve, neoprene sealing grommets and PVC coated steel pressure rings. Supplied with neoprene sealing rings between body and PVC sleeve.
 - b. Watertight cable terminators: One piece, compression molded sealing ring with PVC coated steel pressure disks, stainless steel screws and zinc plated cast iron locking collar.
 - c. Watertight cable/cord connectors: Liquidtight steel or cast malleable iron body with sealing neoprene bushing and stainless steel retaining ring.
 - d. Expansion fittings: Multi-piece unit of hot dip galvanized malleable iron or steel body and outside pressure bussing design to allow a maximum of 4" movement (2" in either direction). Furnish with external braid tinned copper bonding jumper. UL listed for both wet and dry locations.

- e. Expansion/deflection couplings: Multi-piece unit comprised of a neoprene sleeve, internal flexible tinned copper braid attached to bronze end couplings with stainless steel bands. Coupling to provide minimum of 3/4" movement and 30 degrees deflection from normal. UL listed for both wet and dry locations.
- f. Conduit bodies: Raintight, malleable iron, hot-dip galvanized body with threaded hubs, stamped steel cover, stainless steel screws and neoprene gasket.
- g. Other couplings, connectors and fittings shall be equal in quality, material and construction to items specified herein.

B. Boxes

1. Outlet boxes

- a. Standard: Galvanized one-piece of welded pressed steel type in accordance with NEMA OS 1 and UL 514. Boxes shall not be less than 4" square and at least 1 1/2" deep.
- b. Concrete: Galvanized steel, 4" octagon ring with mounting lug, backplate and adapter ring type in accordance with NEMA OS 1 and UL 514. Depth as required by application.
- c. Masonry: Galvanized steel, 3.75" high gang box in accordance with NEMA OS 1 and UL 514.
- d. Surface cast metal: Cast malleable iron body, surface mounted box with threaded hubs and mounting lugs as required in accordance with NEMA OS 1 and UL 514. Furnish with ground flange, steel cover and neoprene gasket.

2. Pull and junction boxes

- a. Sheet metal boxes: Standard or concrete outlet box wherever possible; otherwise use 16 gauge galvanized sheet metal, NEMA 1 box sized per CEC with machine screwed cover.
- b. Cast metal boxes: Install standard cast malleable iron outlet or device box when possible.
- c. Flush mounted boxes: Install overlapping cover with flush head screws.
- d. In-ground mounted pull holes/boxes: Install pre-cast concrete box, sized per Drawing or CEC with pre-cast or traffic rated lid.

3. Floor boxes

- a. Floor boxes shall be adjustable, cast metal body with threaded conduit openings, adjustable rings, brass flange or Lexan ring and cover plate with threaded plug. Include provisions to accommodate surface mounted telephone or receptacle outlet, or flush floor mounted telephone or receptacle outlet where shown on Drawings.

C. Pull line/cord

- 1. Polypropylene braided line or Let-line #232 or equal of 1/8" diameter with a minimum break strength of 200 pounds.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Thoroughly examine site conditions for acceptance of wire and cable installation to verify conformance with manufacturer and specification tolerances. Do not commence with work until all conditions are made satisfactory.

3.02 PREPARATION

A. Conduit

1. Provide all necessary conduit fittings, connectors, bushings, etc. required to complete conduit installation to meet the CEC/NEC and intended application whether noted, shown or specified within.
2. Location of conduit runs shall be planned in advance of the installation and coordinated with other trades.
3. Where practical, install conduits in groups in parallel vertical or horizontal runs that avoid unnecessary offsets.
4. All conduits shall be parallel or at right angles to columns, beams and walls whether exposed or concealed.
5. Conduits shall not be placed closer than 12" to a flue, parallel to hot water, steam line or other heat sources; or 3" when crossing perpendicular to the above said lines when possible.
6. Install exposed conduit as high as practical to maintain adequate headroom. Notify Engineer if headroom will be less than 102".
7. Do not obstruct spaces required by Code in front of electrical equipment, access doors, etc.
8. The largest trade size conduit in concrete floors and walls shall not exceed 1/3 thickness or be spaced a less than three conduit diameters apart unless permitted by Engineer. All conduits shall be installed in the center of slab or wall, and never between reinforcing steel and bottom of floor slab.
9. Install additional pull boxes, not shown on Drawings, in sufficient quantities to facilitate pulling of conductors and cables such that total spacing does not exceed 150 feet or 270 degrees, total; and maximum pulling tension will not be exceeded.
10. When installing underground conduits to specified depth; depth shall be taken from finished grade as it will be at project completion. Should finish grade be above existing grade by an amount equal to or greater than specified depth, conduit shall be installed not less than 6" below existing grade.
11. Verify that information concerning finish grade is accurate, for should the underground run be less than the specified depth, Contractor may be required to re-install conduit to meet the required depth.
12. Unless otherwise specified, underground conduits shall be installed with top side not less than 24" below finished grade; this depth applies to all conduits outside of building foundations including those under walks, open corridors or paved areas.

13. Utility company service conduits installation depth shall be as directed by their respective specifications and requirements.

B. Boxes

1. Before locating outlet boxes, check Construction Documents for type of construction and make sure that there is no conflict with other equipment. Locate outlet boxes as shown and locate so as not to interfere with other Work or equipment.
2. Install all outlet boxes flush within walls, ceiling and floors except where installed within non-finished rooms, cabinetry, attic spaces or as indicated on Drawings.
3. Locate pull boxes and junction boxes within concealed, accessible locations where possible.
4. Do not install outlet boxes back-to-back with same stud space. Where shown back-to-back, offset as required, and fill void with sound dampening material where requested by Owner.
5. In fire rated walls separate boxes by 24" minimum and with stud member.
6. Adjust position of outlet boxes within masonry wall to accommodate course lines.

3.03 INSTALLATION

A. Conduit

1. Minimum conduit size shall be 3/4" unless otherwise indicated.
2. All conduit work shall be concealed unless otherwise indicated. Exposed conduits shall be permitted within unfinished rooms/spaces to facilitate installation.
3. Install conduit in complete runs prior to installing conductors or cables.
4. Make long radius conduits bends free from kink, indentations or flattened surfaces. Make bends carefully to avoid injury or flattening. Bends 1 1/4" size and larger shall be factory made ells, or be made with a manufactured mechanical bender. Heating of steel conduit to facilitate bending or that damage galvanized coating will not be permitted.
5. Remove burrs and sharp edges at end of conduit with tapered reamer.
6. Protect and cover conduits during construction with metallic bushings and bushing "pennies" to seal exposed openings.
7. Assemble conduit threads with anti-corrosion, conductive, anti-seize compound and tighten securely.
8. Install conduits shall that no traps to collect condensation exist.
9. Fasten conduit securely to boxes with locknuts and bushings to provide good grounding continuity.
10. Install pull cords/line within any spare or unused conduits of sufficient length to facilitate future cable installation.

11. Penetrations

- a. Locate penetrations within structural members as shown on Drawings and as directed by Architect or Engineer. Should it be necessary to notch any framing member, make such notching only at locations and in a manner as approved by Engineer.
- b. Do not chase concrete or masonry to install conduit unless specifically approved by Engineer.
- c. Cutting or holes
 - 1) Install sleeves for cast-in-place concrete floors and walls. After installing conduit through penetration, seal using dry-pack grouting compound (non-iron bearing, chloride free and non-shrinking) or fire rated assembly if rated floor or wall. Use escutcheon plate on floor underside to contain compound as necessary.
 - 2) Cut holes with a hole saw for penetrations through non-concrete or non-masonry members.
 - 3) Provide chrome plated escutcheon plates at all publicly exposed wall, ceiling and floor penetrations.
- d. Sealing
 - 1) Non-rated penetration openings shall be packed with non-flammable insulating material and sealed with gypsum wallboard taping compound.
 - 2) Fire rated penetration shall be sealed using a UL classified fire stop assembly suitable to maintain the equivalent fire rating prior to the penetration.
 - 3) Use escutcheon plates to hold sealing or fire rated compound as necessary.
- e. Waterproofing
 - 1) Make penetrations through any damp-proofed/waterproofed surfaces within damp/wet locations as such as to maintain integrity of surface.
 - 2) Install specified watertight conduit entrance seals at all below grade wall and floor penetrations.
 - 3) At roof penetrations furnish roof flashing, counter flashing and pitch-pockets compatible to roof assembly.
 - 4) Where possible conduits that horizontally penetrate a waterproof membrane shall fall away from and below the penetration's exterior side.
 - 5) Make penetrations through floors watertight with mastic, even when concealed within walls or furred spaces.

12. Supports

- a. Conduits shall be support and braced per OSHPD pre-approved anchorage systems when those methods are implemented and installed.
- b. Sizes of rods and cross channels shall be capable of supporting 4 times and 5 times actual load, respectively. Anchorage shall support the combined weight of conduit, hanger and conductors.

- c. Support individual horizontal conduit 1 1/2" and smaller by means of 2 hole straps or individual hangers.
- d. Galvanized iron hanger rods sizes 1/4" diameter and larger with spring steel fasteners, clips or clamps specifically design for that purpose for 1 1/2" conduits and larger.
- e. Support multi-parallel horizontal conduits runs with trapeze type hangers consisting of 2 or more steel hanger rods, preformed cross channels, 'J' bolts, clamps, etc.
- f. Support conduit to wood structures by means of bolts or lag screws in shear, to concrete by means of insert or expansion bolts and to brickwork by means of expansion bolts.
- g. Support multi-parallel vertical conduits runs with galvanized Unistrut, Power-Strut or approved equal type supports anchored to wall. Where multi-floored conduits pass through floors, install riser clamps at each floor.
- h. Maximum conduit support spacing shall be in accordance with NECA Standard of Installation:
 - 1) Horizontal runs:
 - a) 3/4" and smaller at 60" on centers, unless building construction prohibits otherwise, then 84" on centers.
 - b) 1" and larger at 72" on centers, unless building construction prohibits otherwise or any other condition, then 120" on centers.
 - 2) Vertical runs:
 - a) 3/4" and smaller @ 84" on centers.
 - b) 1" and 1 1/4" @ 96" on centers.
 - c) 1 1/2" and larger @ 120" on centers.
 - d) Any vertical condition such as shaftways and concealed locations for any sized conduit, 120" on centers.
- i. Anchorage for RMC/IMC supports unless otherwise specified:
 - 1) < 1" IMC/RMC = #10 bolt/screw.
 - 2) 1" IMC/RMC = 1/4" bolt/screw.
 - 3) 1 1/2" and 2" IMC/RMC = 3/8" bolt/screw.
 - 4) 3" IMC/RMC, 4" EMT = 1/2" bolt/screw.
 - 5) > 3" IMC/RMC = 5/8" bolt/screw.
- j. Anchorage for EMT supports unless otherwise specified:
 - 1) < 1 1/2" EMT = #10 bolt/screw.
 - 2) 1 1/2" EMT = 1/4" bolt/screw.
 - 3) 2, 2 1/2" and 3" EMT = 3/8" bolt/screw.
 - 4) 4" EMT = 1/2" bolt/screw.
 - 5) > 4" EMT = 5/8" bolt/screw.

B. Boxes

1. Install boxes as shown on Drawings and as required for splices, taps, wire pulling, equipment connections and Code compliance.
2. Install additional pull boxes, not shown on Drawings, in sufficient quantities to facilitate pulling of conductors and cables such that total spacing does not exceed 150 feet or 270 degrees, total; and maximum pulling tension will not be exceeded.
3. Install plaster rings on all outlet boxes in stud walls or in furred, suspended or exposed ceilings. Covers shall be of a depth suited for installation.
4. Provide gasketed cast metal cover plates where boxes are exposed in damp or wet locations
5. Install access door for boxes installed within concealed locations without access.
6. Install approved factory made knockout seal where knockouts are not present.
7. Refer to Architectural interior elevations and details shown for exact mounting heights of all electrical outlets. In general, locate outlets as shown or specific and complies with Americans with Disabilities Act:
 - a. Convenience outlets: +18"AFF or +6" above counter or splash.
 - b. Local switches: +48"AFF or +6" above counter or splash.
 - c. Telecommunication outlets: +18"AFF or +48"AFF for wall telephone or intercom device.
 - d. Verify all mounting heights with Architectural Drawings, and where heights are not suited for construction or finish please consult Engineer or Architect.
8. Use conduit bodies to facilitate pulling of conductor or cables or change conduit direction. Do not splice within conduit bodies.
9. Enclose pull box with additional rated gypsum board as necessary to maintain wall's original fire rating.
10. Install galvanized steel coverplates on all open boxes within dry listed areas.
11. Install in-ground pull holes/boxes flush to grade finish at finished areas or 1" above finished landscaped grade. Seal all conduits terminating in pull hole/box watertight. Install and grout around bell ends where shown. Cover and lids shall be removable without damage to adjacent finish surfaces.
12. Support
 - a. Accurately place boxes for finish, independently and securely supported by adequate blocking or manufacturer channel type heavy-duty box hangers for stud walls. Do not use nails to support boxes.
 - b. Support boxes independent of conduit system.
 - c. Mount boxes installed within ceilings to 16 gauge metal channel bars attached to main runners or joists.
 - d. Support boxes within suspended acoustical tile ceilings directly from structure above when light fixture are to be installed from box.

- e. Use auxiliary plates, bar or clips and grouted in place for masonry, block or pour-in-place concrete construction.

3.04 APPLICATION

A. Conduit

1. RMC/IMC suitable for all damp, dry and wet locations except when in contact with earth. IMC not suitable for hazardous locations as stated within CEC/NEC.
2. CRMC suitable for damp or wet locations, concealed within concrete or in contact with earth.
3. EMT suitable for exposed or concealed dry, interior locations.
4. PVC/RTRC suitable for beneath ground floor slab, except when penetrating, and direct earth burial. Do not run exposed within concrete walls or in floor slab unless indicated on Drawings or per Engineer's permission.
5. FMC suitable for dry locations only for connections to motors, transformers, vibrating equipment/machinery, controllers, valves, switches and light fixtures in less than 6 foot lengths.
6. LFMC application same as FMC above but for damp or wet locations.

B. Termination and joints

1. Use raceway fittings compatible with associated raceway and suitable for the location.
2. Raceways shall be joined using specified couplings or transitions where dissimilar raceway systems are joined.
3. Conduits shall be securely fastened to cabinets, boxes and gutters using (2) two locknuts and insulating bushing or specified insulated connector. Where joints cannot be made tight and terminations are subject to vibration, use bonding jumpers, bonding bushings or wedges to provide electrical continuity of the raceway system. Use insulating bushings to protect conductors where subjected to vibration or dampness. Install grounding bushings or bonding jumpers on all conduits terminating at concentric or eccentric knockouts.
4. Terminations exposed at weatherproof enclosures and cast outlet boxes shall be made watertight using specified connectors and hubs.
5. Stub freestanding equipment conduits through concrete floors for connections with top of coupling set flush with finished floor. Install plugs to protect threads and entrance of debris.
6. Install specified cable sealing bushings on all conduits originating outside the building walls and terminating within interior switchboard, panel, cabinet or gutters. Install cable sealing bushings or raceway seal for conduit terminations in all grade level or below grade exterior pull, junction or outlet boxes.
7. Where conduits enter building from below grade inject into filled raceways pre-formulated rigid 2 lbs. density polyurethane foam suitable for sealing against water, moisture, insects and rodents.

8. Install expansion fitting or expansion/deflection couplings per manufacturer's recommendations where:
 - a. Any conduit that crosses a building structure expansion joint; secure conduit on both sides to building structure and install expansion fitting at joint.
 - b. Any conduit that crosses a concrete expansion joint; install expansion/deflection at joint.
 - c. Any conduit greater than 1-1/4" is routed along roof top in runs greater than 100 feet; install expansion fittings every 100 feet.
 - d. Engineer may allow FMC or LFMC in lieu of expansion fitting or expansion/deflection couplings on conduits 2" and smaller within accessible locations upon further review and written consent.
- C. Boxes
1. Standard type suitable for all flush installations and all dry concealed locations.
 2. Concrete type suitable for all flush concrete installations.
 3. Masonry type suitable for all flush concrete and block installations.
 4. Surface cast metal type suitable for all exposed damp and wet surface mounted locations, and dry surface mounted locations less than 96" from finished floor

END OF SECTION

SECTION 26 22 00

DISTRIBUTION DRY-TYPE TRANSFORMERS (600VAC AND LESS)

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to transformers

B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
 - a. 26 05 26 – Grounding and Bonding for Electrical Systems
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.02 REFERENCES

A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. ANSI - American National Standards Institute
 - a. C57; Distribution and Power Transformers, Guide for Loading Dry-Type
2. CCR –California Code of Regulations, Title 24
 - a. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
3. NECA –National Electrical Contractors Association
 - a. 409; Recommended Practices for Installing and Maintaining Dry-Type Transformers
4. NEMA –National Electrical Manufacturer's Association
 - a. ST20; Dry Type Transformers for General Applications
 - b. TP1; Guide for Determining Energy Efficiency for Distribution Transformers
 - c. TP2; Standard Test Method for Measuring the Energy Consumption of Distribution Transformers
 - d. TP3; Standard for the Labeling of Distribution Transformer Efficiency
 - e. TR1; Transformers, Regulators, and Reactors

- 5. UL -Underwriters Laboratories, Inc.
 - a. 1561; Dry-Type General Purpose and Power Transformers

1.03 SUBMITTALS

- A. Submit manufacturer's data for materials specified within this Section in accordance to Section 26 05 00.
- B. Include outline and support point dimensions of enclosures and accessories; unit weights; voltage; kVA rating; impedance rating and characteristics; loss and efficiency data at 25%, 50%, 75% and 100% rated load; sound level, tap configurations; insulation system type; and rated temperature raised.

1.04 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.
- B. Installation shall conform to NECA 409-2002, Recommended Practice for Installing and Maintaining Dry-Type Transformers.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Store in a warm, dry location with uniform temperature. Protect unit if handled in inclement weather (i.e., rain, sleet, snow, etc.). Cover ventilating opening to keep out dust and foreign materials prior to startup.
- B. Handle transformer using only lifting eyes and brackets provided for that purpose; see manufacturer's installation instructions.

PART 2 - PRODUCTS

2.01 GENERAL PURPOSE

- A. Manufacturers
 - 1. Square D, Cutler-Hammer or approved equal.
- B. Rating Information
 - 1. All insulating materials are to exceed NEMA ST20 standards and be rated for 220°C UL component recognized insulation system.
 - 2. Capable of meeting daily overload requirements of ANSI C57.96.
 - 3. Transformers 15kVA and larger shall be 150°C temperature rise above 40°C ambient. Transformers 25kVA and larger shall have a minimum of 4 - 2.5% full capacity primary taps.
 - 4. The maximum temperature of the top of the enclosure shall not exceed 50°C rise above a 40°C ambient.
 - 5. Sound levels shall be warranted by the manufacturer not to exceed NEMA ST20 requirements.

C. Construction

1. Transformer coils shall be of the continuous wound construction and shall be impregnated with nonhygroscopic, thermosetting varnish.
2. All cores to be constructed with low hysteresis and eddy current losses. Magnetic flux densities are to be kept well below the saturation point to prevent core overheating. Cores for transformers greater than 500kVA shall be clamped utilizing insulated bolts through the core laminations to ensure proper pressure throughout the length of the core. The completed core and coil shall be bolted to the base of the enclosure but isolated by means of rubber vibration-absorbing mounts. There shall be no metal-to-metal contact between the core and coil and the enclosure except for a flexible safety ground strap. Sound isolation systems requiring the complete removal of all fastening devices will not be acceptable.
3. The core of the transformer shall be visibly grounded to the enclosure by means of a flexible grounding conductor sized in accordance with applicable UL and NEC standards.
4. The transformer enclosures shall be ventilated and be fabricated of heavy gauge, sheet steel construction. The entire enclosure shall be finished utilizing a continuous process consisting of degreasing, cleaning and phosphatizing, followed by electrostatic deposition of polymer polyester powder coating and baking cycle to provide uniform coating of all edges and surfaces. The coating shall be UL recognized for outdoor use.
5. Manufacturer shall provide the optional accessories where required and noted on the Drawings:
 - a. Weathershields for all models.
 - b. Wall mounting brackets for 75kVA units and smaller.
 - c. Ceiling mounting brackets for 150kVA units and smaller.

2.02 ENERGY EFFICIENT, GENERAL PURPOSE

A. Manufacturers

1. Square D, Cutler-Hammer or approved equal.

B. Rating Information

1. Same as General Purpose above except:
 - a. Transformers shall be low loss type with minimum efficiencies per NEMA TP1 when operated at 35% of full load capacity. Efficiency shall be tested in accord with NEMA TP2.

C. Construction

1. Same as General Purpose above.

2.03 PREMIUM GRADE

A. Manufacturers

1. Square D, Cutler-Hammer or approved equal.

B. Rating Information

1. Same as General Purpose above except:
 - a. Transformers 10kVA and larger shall have the following temperature rise above 40°C ambient capable of maintaining a continuous load without exceeding a 150°C rise in a 40°C ambient:
 - 1) 115°C rise with 115% rated load.
 - 2) 80°C rise with 130% rated load.
 - b. The maximum temperature of the top of the enclosure shall not exceed 35°C rise above a 40°C ambient.

C. Construction

1. Same as General Purpose above.

2.04 NON-LINEAR

A. Manufacturers

1. Square D, Cutler-Hammer or approved equal.

B. Rating Information

1. Same as General Purpose above except:
 - a. Neither the primary nor the secondary temperature shall exceed 220°C at any point in the coils while carrying their full rating of non-sinusoidal load. Transformers are to be UL listed and as defined as the sum of fundamental and harmonic $I_h(\text{pu})^2 h^2$ per UL 1561. Transformers evaluated by the UL K-Factor evaluation shall be listed for either 115°C or 80°C average temperature rise as noted on the Drawings. K-Factor listed transformers rated at 150°C rise shall not be acceptable.
 - b. K-Factor rated transformers shall have an impedance range of 3% to 5%, and shall have a minimum reactance of 2% in order to help reduce neutral current when supplying loads with large amounts of third harmonic current.

C. Construction

1. Same as General Purpose above except:
 - a. Transformers shall be supplied with quality, full width electrostatic shields resulting in a maximum effective coupling capacitance between primary and secondary of 33 picofarads. With transformers connected under normal, loaded operating conditions, the attenuation of line noise and transients shall equal or exceed the following limits:
 - 1) Common Mode: 0 to 1.5kHz - 120dB; 1.5kHz to 10kHz - 90dB; 10kHz to 100kHz - 65dB; 100kHz to 1MHz - 40dB
 - 2) Transverse Mode: 1.5kHz to 10kHz - 52dB; 10kHz to 100kHz - 30dB; 100kHz to 1MHz - 30dB

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Examine transformer to provide adequate clearances for installation.
- B. Check that concrete pads are level and free of irregularities for floor mounted installations.
- C. Begin work only after unsatisfactory conditions are corrected.

3.02 INSTALLATION

- A. Read and follow manufacturer's bulletin included with unit prior to installation.
- B. Installation shall conform to NECA 409 where not specified under this Division.
- C. Transformers not specifically designed for wall mounting, shall be spaced a minimum of 6" from adjacent walls, ceiling and all other equipment.
- D. Mount to resist seismic forces and brace to 0.56g. Submit calculations and mounting details for review and approval.
- E. Terminations
 - 1. Provide all transformers with lugs for both primary and secondary conductors shown on Drawings. Connect lug to termination point with appropriate size bolt, nut and washers.
 - 2. Use flexible conduit indoors in dry locations or liquid-tight flexible conduit in damp/wet locations for primary and secondary connections to transformer case when less than 48" in length. Connection shall be to enclosure's side panels only unless fed directly below from ground mounted installation or as shown on Drawings.
- F. Grounding
 - 1. Provide a dual rated four-barrel solderless grounding lug with a 5/8"-11 threaded hole. Drill transformer enclosure with 11/16" bit and attach lug to enclosure using a torque bolt and T&B Dragon Tooth transition washer with the following connections:
 - a. Primary feeder ground
 - b. Secondary feeder ground
 - c. Grounding electrode per CEC/NEC 250-30.
 - d. Main bond jumper to neutral (when present)

3.03 FIELD QUALITY CONTROL

- A. Check for damage and tight connections prior to energizing transformer.
- B. Measure primary and secondary voltages, and make appropriate tap adjustments to within 2% of rated voltage

3.04 CLEANING

- A. Touch up scratched or marred surfaces to match original finish.

END OF SECTION

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SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to panelboards.

B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
 - a. 26 05 26 – Grounding and Bonding for Electrical Systems
 - b. 26 28 11 – Overcurrent Protection Devices
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.02 REFERENCES

A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. CCR –California Code of Regulations, Title 24
 - a. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
2. Federal Specification
 - a. W-C-375; Circuit Breakers, Molded Case, Branch Circuit and Service
3. NECA –National Electrical Contractors Association
 - a. 407, Recommended Practice for Installing and Maintaining Panelboards
4. NEMA –National Electrical Manufacturer's Association
 - a. AB 1; Molded Case Circuit Breakers
 - b. PB 1; Panelboards
 - c. PB 1.1; Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less
5. UL -Underwriters Laboratories, Inc.
 - a. 50; Cabinets and Boxes
 - b. 67; Panelboards

- c. 98; Enclosed and Dead Front Switches
- d. 489; Molded-Case Circuit Breakers and Circuit Breaker Enclosures
- e. 891; Dead-Front Switchboards
- f. 943; Ground Fault Circuit Interrupters
- g. 977; Fused Power Circuit Devices⁵⁰; Enclosures for Electrical Equipment

1.03 SUBMITTALS

- A. Submit manufacturer's data for materials specified within this Section in accordance to Section 26 05 00.
- B. Submittal shall show the following information: circuit breaker numbering, circuit breaker type and short circuit rating, provisions for future circuit breakers, bussing, including neutral and ground, ratings and enclosure dimensions and trims.

1.04 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Handle carefully to avoid damage to internal components, enclosure and finish.
- B. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional cover to protect enclosure in harsh environments.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Square D, Cutler-Hammer or approved equal.

2.02 MATERIALS

A. Panelboards

1. Interior

- a. Shall be factory-assembled with voltage, ampacity, and short circuit rating as shown in Drawings.
- b. Provide 1 continuous copper bus bar per phase. Each bus bar shall have sequentially phase branch circuit connectors suitable for plug-on or bolt-on branch circuit breakers. The bussing shall be fully rated. Panelboard bus current rating shall be determined by heat-rise tests conducted in accordance with UL 67. Panelboards shall be suitable for use as Service Equipment when application requirements comply with UL 67 and CEC/NEC 230.F and 230.G.
- c. All current-carrying parts shall be insulated from ground and phase-to-phase by high dielectric strength material.

- d. Interior trim shall be of dead-front construction to shield user from energized parts. Dead-front trims shall have pre-formed twist-out covering unused mounting spaces.
 - e. Nameplates shall contain system information and catalog number or factory order number. Interior wiring diagram, neutral wiring diagram, UL Listed label and short circuit current rating shall be displayed on the interior.
 - f. Main and sub-feed circuit breakers shall be vertical mounted. Interior leveling provisions shall be provided for flush mounted applications.
2. Main Circuit Breaker
- a. Circuit breaker shall be of type, rating and poles shown on Drawings per Section 26 28 11 – Overcurrent Protection Devices.
3. Branch Circuit Breakers
- a. Circuit breakers shall be of type, rating and poles shown on Drawings per Section 26 28 11 – Overcurrent Protection Devices.
4. Enclosures
- a. Type NEMA 1 Boxes
 - 1) Boxes shall be galvanized steel constructed in accordance with UL 50 requirements. Galvanealed steel will not be acceptable.
 - 2) Boxes shall have removable endwalls with knockouts located on one end. Boxes shall have welded interior mounting studs. Interior mounting brackets are not required.
 - 3) Box width shall be 20 in wide.
 - b. Type NEMA 1 Fronts
 - 1) Front shall meet strength and rigidity requirements per UL 50 standards. Front shall have ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.
 - 2) Fronts shall be hinged 1-piece with door. Mounting shall be as indicated in Drawings.
 - 3) Panelboards rated 225 amperes and below shall flat fronts with concealed door hinges and trim screws. Front shall not be removable with the door locked. Panelboards rated above 225 amperes shall have fronts with trim clamps and concealed door hinges. Front doors shall have rounded corners and edges shall be free of burrs.
 - 4) Front shall have cylindrical tumbler type lock with catch and spring-loaded stainless steel door pull. All lock assemblies shall be keyed alike. Two (2) keys shall be provided with each lock. A clear plastic directory cardholder shall be mounted on the inside of door.
 - c. Type NEMA 3R, 5, and 12
 - 1) Enclosures shall be constructed in accordance with UL 50 requirements. Enclosures shall be painted with ANSI 49 gray enamel electrodeposited over cleaned phosphatized steel.

- 2) All doors shall be gasketed and equipped with a tumbler type vault lock. All lock assemblies shall be keyed alike. 2 keys shall be provided with each lock. A clear plastic directory cardholder shall be mounted on the inside of door.
- 3) Maximum enclosure dimensions shall not exceed 20 in wide and 6.5 in deep.

PART 3 - EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's written instructions and NEMA PB 1.1.
- B. Installation shall conform to NECA 407 where not specified under this Division.
- C. Anchor panelboards to structural members and as shown on Drawings. Provide additional support as required. Anchor freestanding distribution panels to concrete pad.
- D. Mount panelboards level and plumb.
- E. Install flush mounted panel backbox front edges flush with finished wall. Where flush panel backbox is deeper than wall depth, install closing trim of wood or metal to provide a finished trim.
- F. Where panelboard is flush in wall, provide one $\frac{3}{4}$ " conduit stub into accessible ceiling above for every 5 spare circuit breaker or available space.
- G. After installation, make all feeder connections to circuit breaker load side lugs and incoming secondary feeders.

3.02 FIELD QUALITY CONTROL

- A. Inspect complete installation prior to energizing for physical damage, proper alignment, anchorage and grounding.
- B. Check tightness of bolted connections and circuit breaker connections using a calibrated torque wrench or torque screwdriver per manufacturer's written specifications.

3.03 ADJUSTING

- A. Measure steady state load line currents at each panelboard feeder; rearrange panelboard circuits to balance the phase loads with 20% of each other. Maintain proper phasing for multi-wire branch circuits.

3.04 SCHEDULES

- A. Fill out panelboard circuit identification card, typewritten, with list of circuits in use. Identification shall be specific with room designation and other information as necessary. For distribution panels, use engraved laminated phenolic plates showing load served.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes
 - 1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to wiring devices.
- B. Related sections
 - 1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
 - a. 26 05 26 – Grounding and Bonding for Electrical Systems
 - 2. The requirements of this Section apply to all Division 26 work, as applicable.
 - 3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.02 REFERENCES

- A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:
 - 1. Federal Specification
 - a. W-C-596; Connector, Electrical, Power, General Specification for
 - b. W-S-896; Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification)
 - 2. NEMA –National Electrical Manufacturer's Association
 - a. WD 1; General Color Requirements for Wiring Devices
 - b. WD 6; Wiring Devices-Dimensional Requirements
 - 3. UL -Underwriters Laboratories, Inc.
 - a. 20; General-Use Snap Switches
 - b. 498; Standard for Attachment Plugs and Receptacles
 - c. 943; Standard for Ground-Fault Circuit-Interrupters
 - d. 1449; Standard for Transient Voltage Surge Suppressors

1.03 SUBMITTALS

- A. Submit manufacturer's data for materials specified within this Section in accordance to Section 26 05 00.

1.04 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

PART 2 - PRODUCTS

2.01 SWITCHES

- A. Wall switches
 - 1. Specification grade, quiet, AC rated, mechanical, snap type with silver alloy contacts, and shall comply with NEMA WD-1 and Fed. Spec W-S-896.
 - 2. Rating shall be 20A at 120/277Vac, unless otherwise shown.
 - 3. Handles shall be nylon; color shall be compatible with adjacent wall finish.
 - 4. Manufacturers and types
 - a. Single pole, single throw
 - 1) Cooper Wiring Devices #CSB120, Hubbell #CSB120, or equal.
 - b. Double pole, single throw
 - 1) Cooper Wiring Devices #CSB220, Hubbell #CSB220, or equal.
 - c. Three way
 - 1) Cooper Wiring Devices #CSB320, Hubbell #CSB320, or equal.
- B. Wall dimmer switches
 - 1. Linear slide type dimmer with smooth and continuous square law dimming curve that complies with UL 20 and is UL listed for the specified load.
 - 2. Dimmers shall have power failure memory to bring lights back on at same level prior to power interruption.
 - 3. Dimmers shall incorporate air-gap switch accessible with wall plate installed.
 - 4. Furnish dimmer switch of rating to connected loads; de-rate as required by manufacturer's information for ganged installations.
 - 5. Coverplate shall be snap-on type with no visible attachments or fins. Color shall be compatible with adjacent wall finish.
 - 6. Manufacturer and type
 - a. Lutron Nova series or approved equal.

2.02 RECEPTACLES

- A. Standards
 - 1. Specification grade, NEMA 5-15R configuration grounding type, rated 15A at 125/250Vac that conform to NEMA WD-6 and Fed. Spec W-C-596.
 - 2. At dedicated receptacle locations and as otherwise noted, use specification grade, NEMA 5-20R configuration grounding type, rated 20A at 125/250Vac that conform to NEMA WD-6 and when possible Fed. Spec W-C-596.
 - 3. Specialty receptacles shall conform to NEMA WD-6 and UL standards as applicable.
- B. Color
 - 1. General purpose receptacle face shall be nylon; color shall be compatible with adjacent wall finish, unless otherwise indicated.

C. Receptacle types

1. General purpose single

- a. Provide self-grounding back and side wired with binding head staked terminal screw.
- b. Use Cooper Wiring Devices #5261, Hubbell #5261, or equal for NEMA 5-15R.
- c. Use Cooper Wiring Devices #5361, Hubbell #5361, or equal for NEMA 5-20R.

2. General purpose duplex

- a. Provide self-grounding back and side wired with binding head staked terminal screws and break-off strip for two circuit wiring.
- b. Use Cooper Wiring Devices #5262, Hubbell #5262, or equal for NEMA 5-15R.
- c. Use Cooper Wiring Devices #5362, Hubbell #5362, or equal for NEMA 5-20R.

3. Transient voltage surge suppressor (TVSS) duplex

- a. Provide 20A, 125Vac receptacle consisting of NEMA 5-20R duplex device with integral TVSS protection circuit.
- b. Provide LED indicator to verify surge protection and ground, and audible alarm to notify bad ground connection or surge protection expiration.
- c. TVSS characteristics:
 - 1) 400V clamping voltage.
 - 2) 280J energy rating.
 - 3) 150Vac RMS MOV rating
 - 4) 18kA maximum surge current in all modes (L-N, L-G and N-G)
- d. Use Cooper Wiring Devices #5362_S, no known equal.

4. Isolated ground

- a. Provide receptacle specified within this Section with equipment grounding contacts connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap.

5. Ground fault circuit interrupter (GFCI) duplex

- a. Provide 20A, 125Vac receptacle consisting of NEMA 5-20R duplex device with integral solid state sensing and signaling circuitry capable of detecting and interrupting a maximum 5mA line-to-ground fault current in approximately 1/40th of a second per UL 943.
- b. Provide visual device with trip indication, manual reset and test mechanisms per UL 943.
- c. Device shall be capable of point of use and multi-outlet protection.
- d. Use Cooper Wiring Devices #XGF20, Hubbell #GF53, or equal.

6. Hospital grade and tamper resistant
 - a. Provide receptacle specified within this Section that conforms to UL 498 "Hospital Grade" requirements.
 - b. Tamper resistance receptacle shall have integral protection mechanism to prevent accidental shock from foreign object contacting energized blades.
7. Special purpose
 - a. Provide specification grade devices with NEMA configuration, voltage, ampacity, poles and ground provisions as noted on Drawings.

2.03 WALL PLATES

- A. Interior locations
 1. Finished Areas: 0.032" stainless steel, brushed or satin finish with required number of openings for location.
 2. Exposed Areas: galvanized, raised type.
- B. Exterior: die-cast copper-free aluminum, gasketed, raintight cover UL listed for exterior and wet locations while in use. Use Hubbell #WP8M (duplex), #WP26M (GFCI) or equal.
- C. Screws shall match plate.
- D. Tamper resistance receptacles shall have exposed screws of temper resistant type.
- E. Individual, gangable wall plates are not acceptable where two or more devices are installed at one location.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Coordinate device heights with architectural drawings and details.
- B. Locate switches on latch side of door, unless otherwise indicated.

3.02 INSTALLATION

- A. Mount and align device and wall plates level and plumb. Insure wall plates fit flat against wall and tight against device without strain on plate.
- B. Comply with manufacturer's instructions regarding termination of conductors to wiring device.
- C. Derate ganged dimmer switches as instructed by manufacturer and use dedicated neutrals within all dimmer circuits.
- D. Provide wall plates for all outlet boxes with devices.
- E. Install blank wall plates on all outlet boxes in which no device is present or installed.

END OF SECTION

SECTION 26 28 11
OVERCURRENT PROTECTION DEVICES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to overcurrent protection devices.

B. Related sections

1. Where items specified in other Division 26 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
2. The requirements of this Section apply to all Division 26 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.02 REFERENCES

A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. CCR –California Code of Regulations, Title 24
 - a. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
2. Federal Specification
 - a. W-C-375; Circuit Breakers, Molded Case, Branch Circuit and Service
3. NEMA –National Electrical Manufacturer’s Association
 - a. AB 1; Molded-Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures
 - b. PB 2.2; Application Guide for Ground Fault Protective Devices for Equipment
4. UL -Underwriters Laboratories, Inc.
 - a. 248; Low Voltage Fuses
 - b. 468; Wire Connectors
 - c. 508E; IEC Type "2" Coordination Short Circuit Tests
 - d. 489; Molded-Case Circuit Breakers and Circuit Breaker Enclosures
 - e. 943; Standard for Ground-Fault Circuit-Interrupters

1.03 SUBMITTALS

- A. Submit manufacturer’s data for materials specified within this Section in accordance to Section 26 05 00.**
- B. Production test of circuit breakers upon request of Engineer.**

- C. Submittal shall show the following information: circuit breaker numbering, circuit breaker type and short circuit rating, provisions for future circuit breakers, bussing, including neutral and ground, ratings and enclosure dimensions and trims.

1.04 QUALITY ASSURANCE

- A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.
- B. The manufacturing facility shall be registered by Underwriters Laboratories Inc. to the International Organization for Standardization ISO 9002 Series Standards for quality.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Handle carefully to avoid damage to internal components, enclosure and finish.
- B. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional cover to protect enclosure in harsh environments.

PART 2 - PRODUCTS

2.01 FUSES

- A. All power distribution fuses shall be time-delay, high interrupting (200kAIC minimum) and current limiting type, unless otherwise indicated. All fuses shall be of same manufacturer and model.
 - 1. Motor branch circuit fuses (0 – 600A): UL Class RK5 dual element, time delay type shall be size for UL 508E “Type 2” coordination for the motor controller. Coordinate fuse selection with motor starter overload relay heaters as required.
 - 2. General purpose feeder fuses (0 – 600A): UL Class RK1 dual element, time delay type shall be size per Drawings.
- B. Control and instrumentation fuses shall of type and rating as recommended by equipment manufacturer, suitable for fuse blocks or holders installation.

2.02 MOLDED CASE CIRCUIT BREAKERS

- A. General
 - 1. Circuit breakers shall be constructed using glass reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
 - 2. Circuit breakers shall have an over center, trip free, toggle operating mechanism which will provide quick-make, quick-break contact action. The circuit breaker shall have common tripping of all poles.
 - 3. The circuit breaker handle shall reside in a tripped position between ON and OFF to provide local trip indication.
 - 4. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker after installation.
 - 5. Circuit breakers shall have an RMS interrupting capacity not less than shown on Drawings, or if not shown shall not be less than:
 - a. 25kA for 480V systems
 - b. 22kA for 240V (or less) systems

6. Each circuit breaker shall be equipped with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit breaker tripping mechanism for maintenance and testing purposes.
 7. Circuit breakers shall be equipped with UL Listed electrical accessories as noted on Drawing. Circuit breaker handle accessories shall provide provisions for locking handle in the ON and OFF position.
 8. All circuit breakers shall be UL Listed for reverse connection without restrictive line and load markings and be suitable for mounting in any position.
 9. Circuit breakers shall be constructed with factory installed mechanical lugs. All circuit breakers shall be UL Listed to accept field installable/removable mechanical type lugs. Lug body shall be bolted in place; snap in design not acceptable. All lugs shall be UL Listed to accept solid (not larger than #8 AWG) and/or stranded copper and aluminum conductors. Lugs shall be suitable for 90°C rated wire, sized according to the 75°C temperature rating in the CEC.
 10. All circuit breakers shall be capable of accepting bus connections.
- B. Thermal-Magnetic Circuit Breakers
1. Circuit breakers shall have a permanent trip unit containing individual thermal and magnetic trip elements in each pole.
 2. Thermal trip elements shall be factory preset and sealed. Circuit breakers shall be true RMS sensing and thermally responsive to protect circuit conductor(s) in a 40°C ambient temperature.
 3. Circuit breaker frame sizes above 100 amperes shall have a single magnetic trip adjustment located on the front of the circuit breaker.
 4. Provide equipment ground fault protection where shown on Drawing with the following features.
 - a. Ground fault sensing system shall be modified zero sequence sensing type and not require any external power to trip the circuit breaker.
 - b. The ground fault sensing system shall be suitable for use on grounded systems. The ground fault sensing system shall be suitable for use on three-phase, three-wire circuits where the system neutral is grounded but not carried through the system or on three-phase, four-wire systems.
 - c. Ground fault pickup current setting and time delay shall be field adjustable. A switch shall be provided for setting ground fault pickup point. A means to seal the pickup and delay adjustments shall be provided.
 - d. The ground fault sensing system shall include a ground fault memory circuit to sum the time increments of intermittent arcing ground faults above the pickup point.
 - e. A means of testing the ground fault system to meet the on-site testing requirements of CEC/NEC 230-95(c) shall be provided.
 - f. Local visual ground fault trip indication shall be provided.
 - g. The ground fault sensing system shall be provided with Zone Selective Interlocking (ZSI) communication capabilities compatible with other thermal magnetic circuit breakers equipped with ground fault sensing, electronic trip circuit breakers with integral ground fault sensing and external ground fault sensing systems as noted on Drawings.

C. Electronic Trip Circuit Breakers

1. Circuit breaker trip system shall be a microprocessor-based true RMS sensing design with sensing accuracy through the thirteenth (13th) harmonic. Sensor ampere ratings shall be as indicated on Drawings.
2. The integral trip system shall be independent of any external power source and shall contain no less than industrial grade electronic components.
3. The ampere rating of the circuit breaker shall be determined by the combination of an interchangeable rating plug, the sensor size and the long-time pickup adjustment on the circuit breaker. The sensor size, rating plug and adjustment positions shall be clearly marked on the face of the circuit breaker. Circuit breakers shall be UL Listed to carry 80% (or 100% where noted on Drawings) of their ampere rating continuously.
4. The following time/current response adjustments shall be provided. Each adjustment shall have discrete settings and shall be independent of all other adjustments.
 - a. Instantaneous Pickup
 - b. Long Time Pickup
 - c. Long Time Delay
 - d. Short Time Pickup
 - e. Short Time Delay
 - f. Ground Fault Pickup (when specified with ground fault protection)
 - g. Ground Fault Delay (when specified with ground fault protection)
5. A means to seal the trip unit adjustments in accordance with CEC/NEC 240-6(b) shall be provided.
6. Local visual trip indication for overload, short circuit and ground fault trip occurrences shall be provided.
7. An ammeter to individually display all phase currents flowing through the circuit breaker shall be provided. All current values shall be displayed in true RMS with 2% accuracy.
8. Long Time Pickup indication to signal when loading approaches or exceeds the adjusted ampere rating of the circuit breaker shall be provided.
9. The trip system shall include a Long Time memory circuit to sum the time increments of intermittent overcurrent conditions above the pickup point. Means shall be provided to reset Long Time memory circuit during primary injection testing.
10. An ammeter to individually display all phase currents flowing through the circuit breaker shall be provided. Indication of inherent ground fault current flowing in the system shall be provided on circuit breakers with integral ground fault protection. All current values shall be displayed in true RMS with 2% accuracy.
11. Circuit breakers shall be equipped with back-up thermal and magnetic trip system.

12. Equipment Ground Fault Protection shall be provided where noted on Drawings.

- a. Circuit breakers shall be provided with integral equipment ground fault protection for grounded systems. The circuit breaker shall be suitable for use on three-phase, three-wire circuits where the system neutral is grounded but not carried through the system or on three-phase, four-wire systems.
- b. A separate neutral current transformer shall be provided for three-phase, four-wire systems.
- c. Ground fault sensing system shall be residual sensing type.
- d. The trip system shall include a ground fault memory circuit to sum the time increments of intermittent ground faults above the pickup point.
- e. A means of testing the ground fault system to meet the on-site testing requirements of CEC/NEC 230-95(c) shall be provided.
- f. Local visual trip indication for a ground fault trip occurrence shall be provided.
- g. The ground fault sensing system shall be provided with Zone Selective Interlocking (ZSI) communication capabilities compatible with other thermal magnetic circuit breakers equipped with ground fault sensing, electronic trip circuit breakers with integral ground fault sensing and external ground fault sensing systems as noted on Drawings.

13. Circuit breaker trip system shall be equipped with an externally accessible test port. Disassembly of the circuit breaker shall not be required for testing. Test set shall be capable of verifying the operation of all trip functions with or without tripping the circuit breaker.

2.03 INSULATED CASE CIRCUIT BREAKERS

- A. Circuit breaker trip system shall be a microprocessor-based true RMS sensing design with sensing accuracy through the thirteenth (13th) harmonic. Sensor ampere ratings shall be as indicated on Drawings.
- B. The integral trip system shall be independent of any external power source and shall contain no less than industrial grade electronic components.
- C. Circuit breakers shall be equipped with back-up thermal and magnetic trip system.
- D. Circuit breakers shall have an RMS interrupting capacity not less than shown on Drawings, or if not shown shall not be less than:
 - 1. 100kA for all frame sizes at 208V
 - 2. 65kA for all 800A - 2,000A frames at 480V
 - 3. 100kA for all 3,000A - 4,000A frames at 480V
- E. The ampere rating of the circuit breaker shall be determined by the combination of an interchangeable rating plug, the sensor size and the long-time pickup adjustment on the circuit breaker. The sensor size, rating plug and switch adjustments shall be clearly marked on the face of the circuit breaker. Circuit breakers shall be UL Listed to carry 100% of their ampere rating continuously.
- F. The following time/current response adjustments shall be provided. Each adjustment shall have discrete settings and shall be independent from all other adjustments.

- a. Instantaneous Pickup
 - b. Long Time Pickup
 - c. Long Time Delay
 - d. Short Time Pickup
 - e. Short Time Delay
 - f. Ground Fault Pickup (when specified with ground fault protection)
 - g. Ground Fault Delay (when specified with ground fault protection)
- G. Circuit breakers with adjustable short-time function shall be provided with defeatable instantaneous adjustment and 30 cycle short-time withstand ratings. Short-time withstand ratings shall be specified in RMS symmetrical amperes, as shown on the [drawings] [schedules].
- H. A means to seal the rating plug and trip unit adjustments in accordance with CEC/NEC 240-6(b) shall be provided.
- I. Local visual trip indication for overload, short circuit and ground fault trip occurrences shall be provided.
- J. An ammeter to individually display all phase currents flowing through the circuit breaker shall be provided. [Indication of inherent ground fault current flowing in the system shall be provided on circuit breakers with integral ground fault protection]. All current values shall be displayed in True RMS with 2% accuracy.
- K. Long Time Pickup indication to signal when loading approaches or exceeds the adjusted ampere rating of the circuit breaker shall be provided.
- L. The trip system shall include a Long Time memory circuit to protect against intermittent overcurrent conditions above the long time pickup point. Means shall be provided to reset Long Time memory circuit during primary injection testing.
- M. True two-step stored energy mechanism with five (5) cycle closing time shall be provided. All circuit breakers shall have multiple CHARGE/CLOSE provisions allowing the following sequence: CHARGE, CLOSE, RECHARGE, OPEN/CLOSE/OPEN
- N. Local control pushbuttons to OPEN and CLOSE circuit breaker shall be provided. Color coded visual indication of contact position (OPEN or CLOSED) shall be provided on the face of the circuit breaker. Local manual charging following CLOSE operation shall be provided. Color coded visual indication of mechanism CHARGED and DISCHARGED position shall be provided on the face of the circuit breaker. Visual indicator shall indicate CHARGED only when closing springs are completely charged.
- O. Each circuit breaker shall be electrically operated to permit remote CHARGE, CLOSE, and OPEN capabilities. Electrically operated circuit breaker shall be equipped with charge contact switch for remote indication of mechanism charge status.
- P. An ammeter to individually display all phase currents flowing through the circuit breaker shall be provided. [Indication of inherent ground fault current flowing in the system shall be provided on circuit breakers with integral ground fault protection]. All current values shall be displayed in True RMS with 2% accuracy.

- Q. All circuit breakers shall be equipped with electrical accessories as noted on Drawings.
- R. Provide the following interlocking capabilities:
 - 1. cell door interlock
 - 2. key interlock for main-tie-main
 - 3. lock off
- S. Circuit breaker trip system shall be equipped with an externally accessible test port. Disassembly of the circuit breaker shall not be required for testing. Test set shall be capable of verifying the operation of all trip functions with or without tripping the circuit breaker.
- T. Equipment Ground Fault Protection shall be provided where noted on Drawings.
 - 1. Circuit breakers shall be provided with integral equipment ground fault protection for grounded systems. The circuit breaker shall be suitable for use on three-phase, three-wire circuits where the system neutral is grounded but not carried through the system or on three-phase, four-wire systems.
 - 2. A separate neutral current transformer shall be provided for three-phase, four-wire systems.
 - 3. Ground fault sensing system shall be residual sensing type.
 - 4. The trip system shall include a ground fault memory circuit to sum the time increments of intermittent ground faults above the pickup point.
 - 5. A means of testing the ground fault system to meet the on-site testing requirements of CEC/NEC 230-95(c) shall be provided.
 - 6. Local visual trip indication for a ground fault trip occurrence shall be provided.
 - 7. The ground fault sensing system shall be provided with Zone Selective Interlocking (ZSI) communication capabilities compatible with other thermal magnetic circuit breakers equipped with ground fault sensing, electronic trip circuit breakers with integral ground fault sensing and external ground fault sensing systems as noted on Drawings.

2.04 DRAWOUT INSULATED CASE CIRCUIT BREAKERS

- A. Main circuit breaker shall meet the same requirements of insulated case circuit breakers and be individually drawout mounted where shown on Drawings.
- B. Sturdy drawout rails shall be permanently attached to the sides of the breaker compartment and retract into the compartment when not in use.
- C. When fully withdrawn, the circuit breaker shall permit access for inspection and testing. Circuit breaker(s) shall also be removable from the rails completely.
- D. When the circuit breaker is in the Connected, Test, or Disconnected positions, or when the circuit breaker is removed from the compartment, the compartment door shall be able to be fully closed and secured.
- E. A removable crank shall be supplied for racking the circuit breaker between the Connected, Test, or Disconnected positions.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Notify Engineer no later than 10 working days for adjustable circuit breaker settings not shown within Drawings. Submit to Engineer the following information:
 - 1. Panel, switchboard name/ID
 - 2. Circuit breaker identifier (i.e., main circuit breaker, load served, etc.)
 - 3. List of necessary settings (i.e., trip settings, time delays, etc.)

3.02 INSTALLATION

- A. Install equipment and their accessories in to manufacturer's instructions, pertinent Codes, and with recognized industry practices to insure device operates properly.
- B. Tighten electrical connectors and terminals in accordance to manufacturer's requirements. Where the manufacturer does not have published torque tightening values, comply with the requirements of UL 468.

3.03 FIELD QUALITY CONTROL

- A. Check tightness of circuit breaker connections using a calibrated torque wrench or torque screwdriver per manufacturer's written specifications.
- B. Obtain the services of an independent testing company who shall provide quality control and adjustments as well as tests for
 - 1. Check each circuit breaker above 100A on a 225A frame for long-time and short-time delay pickup and instantaneous pickup.
 - a. Instantaneous pickup current shall be determined by 4 cycles or less.
 - b. Perform timing test with 300% of breaker trip unit rated current.
 - c. Adjust unit if required, so that the tripping characteristics are within the limits of the published time-current characteristic curves for that particular trip unit.
 - 2. Test and calibrate ground fault protection trip and pickup time on 225A frame breakers and larger.
- C. Physically test key interlock systems to check for proper functionality.
- D. Check and set where required all protective device settings in accordance with approved coordination study settings and conduct ground fault acceptance tests.

3.04 ADJUSTING

- A. Adjust all operating mechanisms for free mechanical movement per manufacturer's specifications.
- B. Adjust circuit breaker trip and time delay settings to values indicated as instructed by Engineer.
 - 1. Check each circuit breaker above 100A, long-time and short-time delay pickup and instantaneous pickup. Instantaneous pickup current shall be determined by

4 cycles or less. Perform timing test with 300% of breaker trip unit rated current. Adjust unit if required, so that the tripping characteristics are within the limits of the published time-current characteristic curves for that particular trip unit.

2. Main circuit breaker ground fault setting shall be per CEC/NEC 230-95(a) or as directed by Engineer.

3.05 PROTECTION

- A. When directed by Engineer provide physical means to “permanently fix” settings for rotary and DIP type switches with a thin coat of clear lacquer.

3.06 CLEANING

- A. Remove marks, dirt and debris from installed equipment surfaces for “new like” appearance.

END OF SECTION

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SECTION 27 15 23
FIBER OPTIC CABLING AND DEVICES

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes

1. Provide all labor, materials and equipment necessary to complete the installation required for the items specified under this Section, including but not limited to fiber optic based data communication cabling systems which include:
 - a. Provide all necessary cabling and termination equipment for a complete cabling system.
 - b. Terminate, test and document fiber optic cabling as detailed within the Specifications.

B. Related sections

1. Where items specified in other Division 27 sections conflict with the requirements of this Section, the most stringent requirement shall govern.
 - a. 27 11 16 – Data Racks and Enclosures
 - b. 27 05 28 – Pathways for Communication System
2. The requirements of this Section apply to all Division 27 work, as applicable.
3. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

1.02 REFERENCES

- A. Comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:**
1. ANSI –American National Standards Institute
 - a. INCITS 263; Fiber Distributed Data Interface (FDDI) - Token Ring Twisted Pair Physical Layer Medium Dependent (TP-PMD)
 - b. ISO/IEC 11801; Information technology - Generic cabling for customer premises
 2. CCR –California Code of Regulations, Title 24
 - a. Part 3 -California Electrical Code(CEC); NFPA 70 National Electrical Code (NEC) with California amendments
 3. CFR –Code of Federal Regulations
 - a. Title 7 –Agriculture, Part 1755 – Telecommunications Standards and Specifications for Materials, Equipment and Construction
 - b. Title 47 –Telecommunication, Part 68 – Connection of Terminal Equipment to the Telephone Network.

4. TIA/EIA –Telecommunications Industry Association/Electronic Industries Alliance

a. Fiber Optic Standards

- 1) TIA/EIA-455 Series; Fiber Optic Test Procedures including TIA/EIA-455-B; Standard Test Procedure for Fiber Optic Fibers, Cables, Transducers, Sensors, Connecting and Terminating Devices, and other Fiber Optic Components, and All latest FOTPs related to fiber optic cables, connectors and passive devices.
- 2) TIA/EIA-4920000-B; Generic Specification for Optical Waveguide Fibers
- 3) TIA/EIA-492A000-A; Sectional Specification for Class Ia Multimode, Graded-Index Optical Waveguide Fibers
- 4) TIA/EIA-492AAAA-A; Detail Specification for 62.5µm Core Diameter/125µm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers
- 5) TIA/EIA-492AAAB; Detail Specification for 50µm Core Diameter/125µm Cladding Diameter Class Ia Graded-Index Multimode Optical Fibers
- 6) TIA/EIA-598-A; Optical Fiber Cable Color Coding
- 7) TIA/EIA-604; Fiber Optic Connector Intermateability Standards
- 8) TIA/EIA-4720000-A; Generic Specification for Fiber Optic Cable
- 9) TIA/EIA-472C000-A; Sectional Specification for Fiber Optic Communications Cable for Indoor Use
- 10) TIA/EIA-472D000-A; Sectional Specification for Fiber Optic Communications Cable for Outside Plant Use
- 11) TIA/EIA-4750000-C; Generic Specification for Fiber Optic Connectors
- 12) TIA-5150000; Generic Specification for Optical Fiber and Cable Splices
- 13) TIA-515B000; Sectional Specification for Splice Closures for Pressurized Aerial, Buried, and Underground Fiber Optic Cables
- 14) TIA-6090000; Generic Specification for Optical Fiber Splice
- 15) TIA-609A000; Sectional Specification for Conventional, Permanent, Optical Fiber Splice
- 16) TSB62; Informative Test Methods (ITMs) for Fiber-Optic Fibers, Cables, Opto-Electronic Sources and Detectors, Sensors, Connecting and Terminating Devices, and Other Fiber-Optic Components

b. Wiring/Cabling Standards

- 1) TIA/EIA-568-B.1; Commercial Building Telecommunications Cabling Standard - Part 1: General Requirements
- 2) TIA/EIA-568-B.3; Optical Fiber Cabling Components Standard
- 3) TIA/EIA-569-A; Commercial Building Standards for Telecommunications Pathways and Spaces
- 4) TIA/EIA-606; Administration Standard for the Telecommunications Infrastructure of Commercial Buildings

5. ICEA –Insulated Cable Engineers Association
 - a. S-83-596; Fiber Optic Premises Distribution Cable
 - b. S-87-640; Fiber Optic Outside Plant Communications Cable
6. IEEE –Institute of Electrical and Electronic Engineers
 - a. C2; National Electrical Safety Code (NESC)
 - b. 802.3; Information Technology -Local and Metropolitan Area Networks
7. NECA –National Electrical Contractors Association
 - a. NECA/BICSI 568; Standard for Installing Commercial Building Telecommunications Systems
8. Telcordia Documents
 - a. GR-20; Generic Requirements for Optical Fiber and Optical Fiber Cable
 - b. GR-409; Generic Requirements for Premises Fiber Optic Cable
 - c. GR-1435; Generic Requirements for Multi-Fiber Optical Connectors
 - d. GR-2961; Generic Requirements for Multi-Purpose Fiber Optic Cable
9. UL –Underwriters Laboratories, Inc.
 - a. 444; Communications Cables
 - b. 1651; Standard for Optical Fiber Cable
 - c. 1666; Standard Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts
 - d. 1685; Standard for Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables
10. U.S. Department of Agriculture, Rural Utilities Service (RUS), formerly Rural Electrification Administration (REA) Standards
 - a. PE-90; Totally Filled Fiber Optic Cable
 - b. TE&CM Section 644; Design and Construction of Underground Cable

1.03 SYSTEM PERFORMANCE STANDARDS

A. Fiber optic cabling:

1. To applicable EIA/TIA standards using a digital cable analyzer and/or OTDR as specified herein.

1.04 SUBMITTALS

- ##### A. Submit manufacturer's data for materials specified within this Section in accordance to Section 26 05 00.

1.05 QUALITY ASSURANCE

- ##### A. All materials, equipment and parts comprising the materials specified herein shall be new and unused, bearing UL labels where applicable.

B. Installer Qualifications

1. The work performed under this Section shall be certified by the manufacturer of the equipment and components being furnished and be authorized by the manufacturer to install and convey the product warranty and performance guarantee to the Owner upon completion of Contract.
2. Installing Contractor must have a minimum of three years previous experience in data communications and/or telecommunication systems installation. All Contractors and/or Vendors supplying all or parts of the work described herein shall supply three project references within the Submittal package at the Engineer's request, which substantiate the Contractor/Vendors' previous experience as noted herein.

C. Testing Equipment

1. Furnish in conformance with the applicable requirements of this Section.
2. Test systems using at least one each of the following test measurement devices or approved functional equivalents:
 - a. Digital cable analyzer with applicable copper and/or fiber testing standards required within this Section.
 - b. Optical power meter and/or optical time domain reflectometer (OTDR) tester with applicable fiber testing standards required within this Section.
 - c. Any other items of equipment or materials required to demonstrate conformance with the Contract Documents.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Wire shall be in original unbroken package. Obtain approval of Inspector or Engineer before installation of wires.
- B. Handle carefully to avoid damage to internal components, enclosure and finish.
- C. Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional cover to protect enclosure in harsh environments.

1.07 WARRANTY

- A. Furnish guarantee in accordance with and in form required under Section 26 05 00.

PART 2 - PRODUCTS

2.01 FIBER OPTIC COMMUNICATIONS CABLES

A. General Requirements

1. Cabling construction and use shall comply with CEC/NEC Article 770.
2. Fiber count per cable to comply with minimum counts indicated on the Drawings.
3. All fiber optics shall comply with all applicable EIA and Telcordia standards including but not limited to EIA-455, EIA-492, EIA-598, GR-20 and GR-409.
4. All fibers shall be of grade index type.

5. Each fiber to be attenuation tested by the Manufacturer prior to shipping to indicate conformance of shipped cable to requirements herein. Manufacturer's test to be affixed to shipping reel.
6. Maximum required bend radius at installation and long term application should not exceed manufacturer's recommended values.
7. Minimum safe longitudinal load at installation and long term application should not exceed manufacturer's recommended values.
8. Construction
 - a. All dielectric central and strengthen materials.
 - b. Fiberglass epoxy rod/Kevlar strengthening member(s).
 - c. Fiber coating to be mechanically strippable, dual layered, UV-cured acrylate applied by the fiber manufacturer.
 - d. Outer jacket shall be polyethylene, polyurethane or polyvinylchloride with 0.040" minimum thickness as required by application, listings and CEC/NEC requirements.
 - e. Tight Buffer Design
 - 1) Water blocking attributes per EIA-455.
 - 2) Optical fiber surrounding by 250µm primary polymer buffer and 900µm strippable PVC secondary buffer.
 - 3) Individual sub cables supported by being molded into the cable's overall protective jacket ("core locking" design), extruded onto the stranded cable core.
 - 4) Strippable and sliceable directly to loose tube construction 250µm primary coating cable with no interface loss or optical return in excess of standards specified elsewhere herein.
 - 5) Aramid yarn filler, precisely uniformly tensioned around fiber.
 - f. Loose Tube, Gel Filled Design
 - 1) Multiple fiber strands per tube which is kink resistant within specified bend radius.
 - 2) Inorganic, non-hygroscopic, non-nutritive to fungus, electrically non-conductive, homogenous gel which is readily removable with non-toxic solvents.
 - 3) Inorganic, non-hygroscopic binder fill provided to supplement and support uniform cable construction as required.
 - 4) Buffer tubes stranded around central support member using "S-Z" process, left hand lay.
 - 5) Binders to be applied with sufficient tension to secure buffer tubes to the central member without crushing buffer tube(s).
 - 6) High tensile strength dielectric yarns helically woven around cable core to provide tensile strength.
 - 7) Zero flow of filling/gel per FOTP-81.

9. Multi-mode Fiber, General Specifications

- a. All multi-mode fiber installed shall be 50/125 μ m unless otherwise requested by Owner.
- b. Performance and Optical
 - 1) Application Support Distances Minimums
 - a) 10Mb/s Ethernet at 850nm/1300nm: 1250m/1250m
 - b) 100Mb/s Ethernet at 850nm/1300nm: 300m/2000m
 - c) 1Gb/s Ethernet at 850nm/1300nm: 500m/1000m
 - d) 10Gb/s Ethernet at 850nm/1300nm: 300m/300m
 - 2) Attenuation
 - a) 850nm wavelength: $\leq 3.0\text{dB/km}$
 - b) 1300nm wavelength: $\leq 1.0\text{dB/km}$
 - c) No point discontinuity $> 0.2\text{dB}$.
 - d) Attenuation at 1380nm does not exceed attenuation at 1300nm by more than 3.0dB/km .
 - e) Induced attenuation from 100 turns around a 75mm mandrel shall be $\leq 0.5\text{dB}$ at 850nm and 1300 nm.
 - 3) Chromatic Dispersion
 - a) Minimum Zero Dispersion Wavelength: 1300nm
 - b) Maximum Zero Dispersion Wavelength: 1320nm
 - c) Zero Dispersion Slope: $\leq 0.101\text{ps/nm}^2\text{-km}$
 - 4) Effective Modal Bandwidth Minimums
 - a) Laser based systems ($\leq 1\text{Gb/s}$) per EIA-455-204 at 850nm: 510MHz-km
 - b) Legacy and LED based systems ($\leq 100\text{Mb/s}$) per EIA-492:
 - 1) at 850nm: 500MHz-km
 - 2) at 1300nm: 500MHz-km
 - 5) Numerical Aperture: 0.200 ± 0.0015
- c. Environmental
 - 1) Temperature induced attenuation at 850nm and 1300nm from -60°C to 85°C : $\leq 0.20\text{dB/km}$
 - 2) Humidity induced attenuation at 850nm and 1300nm from -10°C to 85°C and 4% to 98% relative humidity: $\leq 0.20\text{dB/km}$
 - 3) Fatigue Resistance Parameter (N_p): ≥ 18
- d. Construction
 - 1) Cladding Diameter: $125 \pm 2.0\mu\text{m}$

- 2) Coating/Cladding Offset: $< 12\mu\text{m}$
- 3) Coating Diameter: $245 \pm 5\mu\text{m}$
- 4) Core/Cladding Offset: $\leq 1.5\mu\text{m}$
- 5) Core Diameter: $50 \pm 3.0\mu\text{m}$
- 6) Non-Circularity Core: $\leq 5\%$
- 7) Non-Circularity Cladding: $\leq 1.0\%$
- 8) Tensile Proof Test: 100kpsi (0.7GPa)

10. Single-mode Fiber, General Specifications

a. Performance and Optical

- 1) Maximum Attenuation
 - a) 1310nm Wavelength: 0.40dB/km
 - b) 1550nm Wavelength: 0.30dB/km
- 2) Chromatic Dispersion
 - a) Zero Dispersion Wavelength: 1317nm
 - b) Zero Dispersion Slope: $\leq 0.088 \text{ ps/nm}^2\text{-km}$
- 3) Mode-Field Diameter
 - a) 1310nm Wavelength: $9.4 \pm 0.4\mu\text{m}$
 - b) 1550nm Wavelength: $10.6 \pm 0.5\mu\text{m}$
- 4) Numerical Aperture: 0.14
- 5) Point discontinuity at 1310nm and 1550nm $\leq 0.05\text{dB}$.

b. Environmental

- 1) Temperature induced attenuation at 1310nm, 1550nm and 1625nm from -60°C to 85°C: $\leq 0.05\text{dB/km}$
- 2) Humidity induced attenuation at 1310nm, 1550nm and 1625nm from -10°C to 85°C and 4% to 98% relative humidity: $\leq 0.05\text{dB/km}$
- 3) Fatigue Resistance Parameter (N_p): ≥ 18

c. Construction

- 1) Cladding Diameter: $125 \pm 0.7\mu\text{m}$
- 2) Coating/Cladding Offset: $< 12\mu\text{m}$
- 3) Coating Diameter: $245 \pm 5\mu\text{m}$
- 4) Core/Cladding Offset: $\leq 0.5\mu\text{m}$
- 5) Core Diameter: $8.2\mu\text{m}$
- 6) Fiber Curl: $\geq 4.0\text{m}$ radius of curvature
- 7) Non-Circularity Cladding: $\leq 0.7\%$
- 8) Tensile Proof Test: 100kpsi (0.7GPa)

B. Indoor, Inside Distribution/Breakout Cable, (Type OFNP)

1. Drawing Reference

- a. Multi-mode: ## FOM-IDW, where ## indicates fiber count
- b. Single-mode: ## FOS-IDW, where ## indicates fiber count

2. Construction

- a. Multi-mode or single-mode fibers as indicated in Drawings per General Requirements listed above.
- b. Breakout style construction per General Requirements listed above with rip cord for outer sheath removal.
- c. Suitable and approved for indoor use within plenum spaces.

3. Manufacturer

- a. Multi-mode: Mohawk RiserLite with AdvanceLite Grade 4, Superior Essex TeraGain or approved equal.
- b. Single-mode: Mohawk RiserLite with AdvanceLite Grade SM1, Superior Essex Singlemode or approved equal.

C. Indoor, Riser (Type OFNR/OFNP)

1. Drawing Reference

- a. Multi-mode: ## FOM-R, where ## indicates fiber count
- b. Single-mode: ## FOS-R, where ## indicates fiber count

2. Construction

- a. Multi-mode or single-mode fibers as indicated in Drawings per General Requirements listed above.
- b. Tight buffered, core lock construction per General Requirements listed above.
- c. Suitable and approved for indoor use within vertical shafts spaces.

3. Manufacturer

- a. Multi-mode: Mohawk RiserLite with AdvanceLite Grade 4, Superior Essex TeraGain or approved equal.
- b. Single-mode: Mohawk RiserLite with AdvanceLite Grade SM1, Superior Essex Singlemode or approved equal.

D. Outdoor, underground (Type OFNR)

1. Drawing Reference

- a. Multi-mode: ## FOM-OSP, where ## indicates fiber count
- b. Single-mode: ## FOS-OSP, where ## indicates fiber count

2. Construction

- a. Multi-mode or single-mode fibers as indicated in Drawings per General Requirements listed above.
- b. Tight buffered or loose tube, gel filled design per General Requirements listed above.

- c. Zero water entry per FOTP-82, 24 hours immersion.
 - d. Flooding compound and general cable construction shall be listed, suitable for underground and wet applications.
- 3. Manufacturer
 - a. Multi-mode: Mohawk RiserLite with AdvanceLite Grade 4, Superior Essex TeraGain or approved equal.
 - b. Single-mode: Mohawk RiserLite with AdvanceLite Grade SM1, Superior Essex Singlemode or approved equal.

2.02 FIBER CABLE TERMINATION DEVICES AND RELATED

A. Connectors

- 1. Types
 - a. Multi-mode: SC type unless otherwise noted, shown or required.
 - b. Single-mode: LC type unless otherwise noted, shown or required.
- 2. Zirconia ceramic ferrule type to suit application.
- 3. Performance
 - a. Insertion Loss
 - 1) Multi-mode: ≤ 0.20 dB, typical
 - 2) Single-mode: ≤ 0.20 dB, typical
 - b. Return Loss
 - 1) Multi-mode: ≤ -30 dB, typical
 - 2) Single-mode: ≤ -55 dB, typical
- 4. Manufacturers
 - a. Siemons, 3M or approved equal.

B. Break-out and Fan-out Kits

- 1. Kits separate six or twelve 250 μm fibers and route them into color-coded 900 μm buffer tubes.
- 2. Manufacturers
 - a. Leviton, Corning Cable Systems or approved equal.

C. Splices

- 1. Mechanical Splices
 - a. Permanent application, integral matching index gel.
 - b. Self-centering fiber alignment mechanism.
 - c. Performance
 - 1) Insertion loss, typical:
 - a) Multi-mode: ≤ 0.30 dB

- b) Single-mode: ≤ 0.15 dB
 - 2) Manufacturer's guaranteed rating worst insertion loss for splice ≤ 0.5 dB.
 - 3) Return Loss
 - a) Flat cleave: ≤ -45 dB
 - b) Angled cleave: ≤ -60 dB
 - 4) Minimum fiber strain relief: 0.75 lbs
 - d. Manufacturers
 - 1) Corning Optical System Camsplice, 3M Fiblok or approved equal.
2. Fusion Splices
- a. Computerized optical aligner and tester with integral fuser.
 - b. Splice protected with a heat shrink cover.
 - c. Insertion loss, typical:
 - 1) Multi-mode: ≤ 0.30 dB, typical
 - 2) Single-mode: ≤ 0.20 dB, typical
 - 3) Manufacturer's guaranteed rating worst case for multi-mode or single-mode splice is ≤ 0.5 dB.
 - d. Manufacturers
 - 1) Corner Cable System or equal.

2.03 FIBER OPTIC TERMINATION EQUIPMENT AND RELATED

A. Fiber Terminal Cabinet, Wall Mount, Patch Panel/Splice Tray

- 1. Drawing Reference:
 - a. ##FTB: Fiber Terminal Box – Patch and cable storage only, where ## refers to fiber port count.
 - b. ##FSB: Fiber Splice Box – Splice only, where ## refers to fiber strand count.
- 2. Fiber Optic Terminal Cabinet
 - a. Provides a location for patching portable and rack mounted equipment to permanently installed fiber infrastructure.
 - b. Constructed of 0.125 inch minimum thick aluminum or powder coated steel with hinged, lockable door.
 - c. Holds a minimum of 4 fiber adapter plates that can each accommodate 6 to 12 single SC, ST or LC termination ports. Install blank adapters as required to fill spaces.
 - d. Two compartment
 - 1) Interior fiber coil rings/splice compartment.
 - 2) Connector interface compartment.

3. Manufacturers
 - a. Leviton 5Wx30, Siemon SWIC3G or approved equal.
- B. Fiber Distribution Panels, Splice and Patch
 1. Drawing References:
 - a. ##FDP – Splice and Patch Panel, where ## refers to fiber port count.
 - b. ##FPP – Patch Panel Only, where ## refers to fiber port count.
 - c. ##FSP – Splice only, where ## refers to fiber port count.
 2. Features/Functions/Performance
 - a. Provides a location for splice, maintenance and cross-connecting of fiber optic cables.
 - b. 19" EIA rack mount with polycarbonate locking door suitable for housing fiber optic splices in a neat and orderly fashion and/or contain a patch panel front.
 - c. Incorporates cable tie downs and routing rings, and should store a minimum of one meter of cable without kinks or twists.
 - d. Suitable for re-entry, if required for future maintenance or modification without damage to the cable or splices.
 - e. All required splice organizer hardware, such as splice trays, protective glass shelves, and shield bond connectors shall be provided in the organizer kit.
 - f. Holds fiber adapter plates that can each accommodate SC, ST or LC termination ports. Install blank adapters as required to fill spaces. The minimum number of fiber terminations per rack unit is as follows:
 - 1) 1 rack unit = 16 fibers
 - 2) 2 rack units = 48 fibers
 - 3) 3 rack units = 96 fibers
 - 4) 4 rack units = 144 fibers
 - 5) 6 rack units = 192 fibers
 3. Manufacturers
 - a. Leviton 5Rx60 series, Siemon RIC3 series or approved equal.
 - C. Fiber Splice Closure
 1. Drawing Reference: FSC
 2. Functions/Features
 - a. Where indicated on plans, provides re-enterable underground splice closure.
 - b. Plastic construction – no corrodible materials.
 - c. Waterproof, suitable for direct burial
 - d. Fusion splice protection chamber
 - e. Grommet cable entrance and exits.

3. Manufacturers

- a. Corning Cable Systems SCF, 3M Fiber Optic Closure System LL or approved equal.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Verify that all raceways have been de-burred and properly joined, coupled, and terminated prior to installation of cables. Verify that all raceways are clear of foreign matter and substances prior to installation of wire or cable.
- B. Inspect all conduit bends to verify proper radius. Comply with Code and cable manufacturer requirements for minimum permissible radius and maximum permissible deformation.

3.02 INSTALLATION

- A. All necessary interconnections, services, and adjustments required for a complete and operable system shall be provided. All installation work must be done in accordance with the safety requirements set forth in the general requirements of IEEE C2 and CEC/NEC 770.
- B. Fiber Installation:
 - 1. All fiber optic cable shall be continuous and splice-free for the entire length of run between designated connections or terminations.
 - 2. At designated splices, maintain conductor color code across all splices.
 - 3. Within buildings, make splices only in designated terminal cabinets and/or on designated equipment backboards.
 - 4. Outdoor splices shall not be permitted except where specifically noted or where required by the run length. Where run lengths require outdoor splices not noted on the drawings, notify Engineer in writing for direction before proceeding.
 - 5. Do not subject cable to tension greater than that recommended by the cable manufacturer. Use multi-spool rollers where cable is pulled in place around bends. Do not pull reverse bends.
 - 6. Provide a box loop for all cable routed through junction boxes or distribution panels. Provide tool formed thermal expansion loops at cable at manholes, handholes and at both sides of all fixed mounted equipment. Cable loops and bends shall not be bent at a radius greater than that recommended by the manufacturer.
 - 7. Secure all cable run vertically for continuous distances greater than thirty (30) feet with symmetrical conforming nonmetallic bushings or woven cable grips appropriate to weight of cable.
 - 8. Where drawings specifically permit use of exposed cable installation in Plenum and/or Suspended Ceiling voids, conform to the following:

- a. Support: Provide support for all cabling. Do not place or attach directly to T-bar grid, concealed spline grid, flexible or rigid ductwork, HVAC registers, sprinkler piping or fixtures, light fixtures.
 - 1) Provide supports at least 48" on center, with cables installed with slight sag to ensure conformance with EIA TSB40 tensioning and stress limits.
 - b. Placement: Do not obscure access to access doors, hatches, air dampers, valves, cable trays, junction boxes, pull boxes or similar areas of access.
 - c. Place EMT pipe sleeves at all wall penetrations. Fire stop sleeves and cables where penetrating a rated wall with an approved UL assembly.
9. Wiring practices
- a. Land all non-coaxial field wiring entering each equipment rack at specified terminal devices prior to connection to any equipment or devices within racks. At Contractor's option and at no additional costs to Owner, such terminals may be located in the equipment racks or in the terminal cabinets provided.
 - b. Apply all crimp connectors only with manufacturer's recommended ratchet type tooling and correct crimp dies for connector and wire size; pliers type crimp tooling shall not be acceptable.
 - c. Coordinate insulation displacement (quick connect) terminal devices with fiber size and type. Comply with manufacturer's recommendations, and make connections with automatic impact type tooling set to a recommended force.
 - d. Dress, lace or harness all wire and cable to prevent mechanical stress on electrical connections. No wire or cable shall be supported by a connection point. Provide service loops where harness of different classes cross or where hinged panels are to be interconnected.
 - e. Correct any and all of the following unacceptable wiring conditions:
 - 1) Deformed, brittle or cracked insulation.
 - 2) Torn or worn cable jacket.
 - 3) Excessively scored cable jackets
 - 4) Insulation shrunken or stripped further than 1/8" away from the actual point of connection within a connector, or on a punch block.
 - 5) Ungrommated, unbushed, or uninsulated wire or cable entries.
 - 6) Deformation or improper radius of wire or cable.
 - f. Limit cable bends to a minimum radius of eight (8) times cable diameter except where otherwise noted herein.
 - g. At junction boxes, form circular radius bends of eight times cable diameter minimum. Up to two (2) flat bends of 90° or less are permitted in any single cable run where necessary to accommodate field wiring conditions. Flat bends exceeding 90° will not be accepted.
 - h. At the receptacle, a single bend of 90° or less and a 1 inch radius shall be permitted subject to the cable manufacturer certification of such an installation. Contractor to field verify the performance of the proposed installation in a mockup using the proposed cabling, jacks, raceway and listed test equipment prior to proceeding.
 - i. Tie wraps to be hand (not tool) tightened.

10. Labeling

- a. Provide permanent identification of run destination at all raceway terminations. Identify at each manhole, vault, handhole, terminal cabinet, pull box, equipment rack and receptacle/outlet.
- b. Unless otherwise noted, conform to the standards and methods of EIA/TIA 606.
- c. Identify all wire and cable clearly with permanent labels rapped about the full circumference within one (1) inch of each connection. Provide any of the following:
 - 1) Continuous permanent imprint; equivalent to Clifford of Vermont, Inc. "Quick-Pull".
 - 2) Direct hot stamp.
 - 3) Heat shrinkable factory hot stamped; equivalent to Bradysleeve heat shrink.
 - 4) Adhesive strip printed labels wrapped the full circumference of the wire and sealed with clear heat shrink tubing; equivalent to Thomas Betts or Panduit Insta-code with clear heat-shrunk tubing equivalent to Alpha.
 - 5) Outside Plant, in Manholes or Pull Boxes. Panduit Fiber Optic Cable Marker Tags (Type PST-FO) or Lead tags, 2" square, drilled for cable attachment. Use cable ties or THWN #12 or 2 #14 wrapped twice around the cable bundle and secure to tag using a crimp fastener.
- d. Indicate:
 - 1) Indicate the number designated on the associated field or shop drawing or run sheet, as applies. Assign wire or cable designations consistently throughout a given system. Each wire or cable shall carry the same labeled designation over its entire run, regardless of intermediate terminations.
 - 2) Indicate installation date.
- e. Terminal cabinet, pull box and manhole, handhole, vault or similar locations subject to abuse, label in accordance to Section 16050.
 - 1) Patching Bays and Jacks and Receptacles containing six or fewer jacks/outlets: Provide designation strip holders with clear plastic covers to retain replaceable designation strips. Provide designation strips with block lettering on permanent background in contrasting color. Use photographic print, laser print on acid free paper, plotting ink on Mylar, or equivalent non-fading process. Alternatively, provide black on white adhesive labels equivalent to those produced by Brother Brand P-Touch Letter Machine. Embossed plastic (Dymo) labels shall not be acceptable. The presence of manufacturer provided silk screen iconic identification labels shall not relieve the contractor from the requirement to identify the receptacle with its associated cabling and circuit.

3.03 FIELD QUALITY CONTROL

A. General

1. Test and report on each intermediate cabling segment separately, including station cabling, horizontal distribution (each segment, if multiple) and telecommunications closet wiring.
2. Test each end to end cable link.
3. Submit copy of final results on paper and in machine readable form, organized by circuit number, consistent with circuit numbering scheme used in preparing submittal drawings and in labeling receptacles and terminations.
 - a. Submit machine-generated documentation and raw data of all test results on Contractor-provided, Owner approved forms; and in electronic format approved by the Owner.
 - b. Where the machine-generated documentation requires use of a proprietary computer program to view the data, provide the Owner with 1 licensed copy of the software.
 - c. Provide registered testing software used for the actual tests to the Owner/Engineer for review of test data as may be required.

B. Fiber Optic Cabling

1. Perform fiber optic cable testing on all installed fiber optic cabling. Notify Owner or Engineer in writing at least 48 hours in advance that fiber optic cable testing shall commence. Submit test results and calibration certification for testing equipment to be used.
2. Submit test report no later than five days after the cables are tested.
3. Attenuation Assessments
 - a. Submit power meter attenuation assessments test results on each fiber strand, in each cable, and in both directions under final installation conditions. Submit with the following information:
 - 1) Date of test
 - 2) Name of test personnel
 - 3) Fiber cable type and part number
 - 4) Fiber number
 - 5) TX wavelength
 - 6) TX location
 - 7) RX location
 - 8) TX model and serial number
 - 9) RX model and serial number
 - 10) Attenuation in dB

4. OTDR Distance and Attenuation Assessments (Contractor to provide only as required for troubleshooting or locating faults on the fiber).
 - a. Test and submit strip charts and/or tracer recordings on all strands in each cable in both directions. Submit with the following information:
 - 1) Date of test
 - 2) Name of test personnel
 - 3) Test wavelength
 - 4) Pulse duration(s) and scale range(s)
 - 5) Index of refraction
 - 6) Fiber cable type and part number
 - 7) Fiber tube and/or fiber strand number
 - 8) Direction of test
 - 9) Overall distance
 - 10) Attenuation in dB
5. Acceptance Tests
 - a. Power Meter Attenuation Test
 - 1) Perform the following measurement attenuation tests using the insertion method. Measure the attenuation of the fiber optic network inclusive of all splices and patch points called for on the Drawings.
 - 2) Measure attenuation between all the couplings using the insertion method.
 - 1) Perform a reference measurement in dBm to determine the injection power level of the stabilized source. Reference cable shall have the same core diameter as strands under test. Connect the optical source directly to the optical power level meter using 2 reference cables and a coupler.
 - 2) Connect the optical source to the strand under test using 1 of the 2 reference cables attached to the strand's terminal coupler.
 - 3) Connect the optical power level meter to the other end of the strand under test through its terminating coupler using the other reference cable.
 - 4) Obtain the measured attenuation (in dB) by subtracting the reference level (dBm) from the received level (dBm).
 - 5) Periodically during the acceptance tests, check and document the reference level.
 - 3) Test each fiber link for overall attenuation from end to end in both directions.
 - b. Perform the attenuation acceptance test at the 850nm wavelength for multi-mode and 1310nm for single-mode

END OF SECTION

SECTION 31 11 00

CLEARING AND GRUBBING

PART 1 GENERAL

1.1 WORK INCLUDED

- A. The work of this section consists of clearing, grubbing, grinding, transporting, removing and disposing of trees, stumps, roots, vegetation debris, and existing improvements, including irrigation systems, sidewalk, curb, gutters, storm drains, landscaping, fencing, utilities, and other protruding obstructions within the clearing limits.
- B. Protect trees, landscaping and shrubs that are not designated to be removed or near construction site that may be harmed by construction activities.

1.2 RELATED WORK

- A. Section 02 41 00 – Demolition
- B. Section 31 23 00 – Earthwork

1.3 REGULATORY REQUIREMENTS

- A. Obtain all required permits.
- B. Dispose of removed materials in a legal manner at an approved disposal facility.
- C. One hundred percent of trees, stumps, rocks and associated vegetation and soils resulting from land clearing shall be reused or recycled.

1.4 REFERENCES

- A. Section 15 – Existing Facilities, State Standard Specifications
- B. Section 19 – Earthwork, State Standard Specifications

PART 2 PRODUCTS

2.1 NOT USED

PART 3 EXECUTION

3.1 CLEARING AND GRUBBING

- A. Clear the specified areas by removing, above the natural ground surface, all existing improvements including curbs, gutters, catch basins, storm drains, landscaping fencing and utilities; vegetable growth such as trees, shrubs, logs, upturned stumps, roots of down trees, brush, and similar material.

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1. Trees of 4-inch diameter and larger shall not be removed without Owner's authorization.
- B. Grub the specified areas below the natural ground surface, except in embankment areas where the grading plane is two feet or more above the natural ground, to a depth necessary to remove all boulders, stumps, roots, buried logs, and other objectionable material including rock and concrete. Remove and stock pile the top 4 inches of topsoil in any area which is to receive structural fill.

3.2 *PRESERVATION*

- A. If indicated or required, preserve trees, plants, rock outcroppings, or other features designated to remain. Protect trees and plants from damage; fell trees in a manner which shall not injure standing trees, plants and improvements which are to be preserved.

3.3 *SALVAGE EQUIPMENT*

- A. Salvaged equipment shall be delivered to the Owner at a designated site.
- B. Equipment to be salvaged is indicated in the Plans and Specifications.

END OF SECTION

SECTION 31 22 19

FINISH GRADING

PART 1 GENERAL

1.1 WORK INCLUDED

- A. All areas within limits of grading and all areas outside limits of grading which are disturbed in the course of the work.

1.2 RELATED WORK

- A. Section 31 23 00 – Earthwork
- B. Section 31 23 17 – Trenching, Backfilling, and Compacting
- C. Section 31 23 19 – Structure Excavation and Backfilling

1.3 REFERENCES

- A. Section 19 – Earthwork, State Standard Specifications

1.4 QUALITY ASSURANCE

- A. Relative Compaction:
 - 1. All costs for initial compaction tests shall be borne by the Owner. All areas that fail to meet the minimum compaction requirements shall be reworked as required by the Engineer and retested until minimum compaction requirements are obtained.
 - 2. The cost of any retests, including time for the Engineer, shall be borne by the Contractor at no additional cost to the project. Testing will be required as directed by the Engineer. Test locations shall be determined by the Engineer upon notification from the Contractor that the grade is ready for tests. Contractor shall be present when samples of materials are gathered for analysis or testing.
- B. Tests for compaction shall conform to references listed in Part 1.3 of this section
- C. Sample backfill materials per ASTM D 75.
- D. Compaction testing will be performed in accordance with Section 19-5.03, State Standard Specifications.
 - 1. Test every 10,000 square feet of engineered fill or aggregate base material placed.

- E. Where compaction tests indicate failure to meet the specified compaction, the Contractor will rework the entire failed area until the specified compaction has been achieved at his sole expense.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Soil:
 - 1. Original surface soil typical of the area.
 - 2. Capable of supporting native and specified plant growth.

PART 3 EXECUTION

3.1 SURFACE FINISH WORK

- A. Grade all disturbed areas, blending with adjacent terrain. Minor irregularities will be permitted.
 - 1. Bring all sub-grades to specified contours, even and properly compacted.
- B. Remove all stones and debris over two inches in any dimension.
- C. Restore drainage ditches to appropriate line and grade, using approved surface erosion prevention techniques.
- D. Clean Up: Remove all rubbish and excess material for disposal as approved, and leave area in a neat, satisfactory condition.

3.2 TOLERANCES

- A. Prior to placing subsequent layers of material thereon, the grading plane shall conform to one of the following:
 - 1. Finish Grading Tolerance: ± 0.10 foot from required elevations
 - 2. When subbase of base material to be placed on the grading plane is to be paid for by the ton, the grading plane at any point shall not vary more than 0.10 FT. above or below the design grade established by the Engineer.
 - 3. When the material to be placed on the grading plane is to be paid for by the cubic yard, the grading plane at any point shall be not more than ± 0.05 foot above the design grade established by the Engineer.
 - 4. When asphalt concrete or asphalt concrete base is to be placed on the grading plane, the grading plane at any point shall not vary more than ± 0.05 foot from the design grade established by the Engineer.

3.3 *ACCEPTANCE*

- A. Upon completion, obtain Engineer's acceptance of grade and surface.

END OF SECTION

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SECTION 31 23 00

EARTHWORK

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Excavate earth and rock as necessary to allow the installation or construction of various items of work, regardless of character and subsurface conditions.
- B. Haul, place, rough grade, compact, and finish grade excavated material as engineered fill on those portions of the project site where it is necessary in order to construct the facilities indicated on the Plans.
- C. Dispose of unsuitable material off-site or in designated areas, as directed by the Engineer.
- D. Prepare excavation and fill for compaction testing.

1.2 RELATED WORK

- A. Section 01 33 00 – Submittals
- B. Section 01 43 00 – Quality Control and Testing
- C. Section 31 11 00 – Clearing and Grubbing
- D. Section 31 22 19 – Finish Grading
- E. Section 31 23 17 – Trenching, Backfilling and Compacting
- F. Section 31 23 19 – Structure Excavation and Backfilling

1.3 REFERENCES

- A. ANSI/ASTM C136 – Sieve Analysis of Fine and Coarse Aggregates.
- B. ANSI/ASTM D1557 – Moisture-Density Relations of Soils and Soil-Aggregate Mixture Using 10 lb (4.54 kg) Hammer and 18-inch (457 mm) Drop.
- C. ANSI/ASTM D1556 – Density of Soil and base rock in Place by Sand-Cone Method.
- D. ASTM D75 Standard Practice for Sampling Aggregates
- E. ASTM D 6938 – Density of soil and base rock in place by Nuclear method.
- F. ASTM D 2937 – Density of soil and in place by Tube method.
- G. Section 26 – Aggregate Bases, State Standard Specifications.
- H. Section 15 – Existing Facilities, State Standard Specifications

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- I. Section 18 – Dust Palliatives, State Standard Specifications
- J. Section 19 – Earthwork, State Standard Specifications
- K. Geotechnical Engineering Investigation entitled, GEOTECHNICAL ENGINEERING INVESTIGATION REPORT, TULARE INDUSTRIAL WASTEWATER TREATMENT PLANT DEWATERING by BSK Associates, dated January 14, 2020.

1.4 PROTECTION

- A. Protect excavations by shoring, bracing, sheet piling, underpinning, or other methods required to prevent cave-in or loose soil from falling into excavation.
 - 1. Trenches shall have sloping, sheeting, shoring, and bracing conforming with 29CFR1926, Subpart P – Excavations, CAL/OSHA requirements, and the Contract Documents.
- B. Notify Engineer of unexpected subsurface conditions.
- C. Protect bottom of excavations and soil adjacent to and beneath foundations from frost.
- D. Grade excavation top perimeter to prevent surface water run-off into excavation.

1.5 CONTROL AND DIVERSION OF WATER

- A. General – The Contractor shall furnish or procure all materials and labor required for constructing and maintaining all necessary cofferdams, channels, flumes, drains, sumps, and/or other temporary diversion and protective works and shall furnish, install, maintain, and operate all necessary pumping and other equipment for removal of water from the various parts of the work and for maintaining the foundations and other parts of the work free from water.
- B. Plan – Prior to beginning any work on the removal of water from foundations, the Contractor shall submit for the Engineer's approval a water control plan showing his proposed method for the removal of water from foundations and other parts of the work.

1.6 SUBMITTALS

- A. Submittals shall be in accordance with Section 01 33 00.
- B. Submit plans as required for work protection against caving ground in excavation. Designs for shoring, bracing, sloping, or similar provisions shall bear the seal of a registered civil or structural engineer licensed to practice in the State of California.

1.1 SAMPLES

- A. Submit samples under provisions of Section 01 43 00.

1.7 QUALITY ASSURANCE

- A. Compaction Testing - All compaction testing shall be in accordance with Section 01 43 00.
- B. Compaction tests will be performed for each lift or layer.
- C. Tests for compaction shall conform to references listed in Part 1.3 of this section
- D. Sample backfill materials per ASTM D 75.
- E. Compaction testing will be performed in accordance with State Standard Specifications, Section 19-6.03.

1.8 DEFINITION

- A. Unsuitable Material: Unsuitable material is material determined to be:
 - 1. Impossible to compact to specified density using ordinary methods at optimum moisture content.
 - 2. Too wet to be properly compacted if circumstances prevent satisfactory in-place drying prior to incorporation into the work.
 - 3. Otherwise unsuitable for the planned use.

1.9 PROJECT CONDITIONS

- A. Underground utilities may exist at this site. Contractor shall take all necessary precautions to protect said utilities. Notify Engineer of any deviation in utility location from that which is shown on the drawings.
- B. Arrange construction sequences to provide the shortest practical time that trenches will be open to avoid hazard to the public, and to minimize the possibility of trench collapse.
- C. Obtain all required permits and licenses before installing utilities and follow the rules and requirements of the authority having jurisdiction.

1.10 EXCAVATION CLASSIFICATION

- A. Regardless of the nature of material excavated, all excavation will be considered unclassified.

1.11 HAND EXCAVATION

- A. Hand excavation will be required within the drip line of selected trees. The Engineer will designate these trees and will direct the performance of said hand excavation.
- B. Unless directed by the Engineer, roots two inches in diameter or larger shall not be cut.

PART 2 PRODUCTS

2.1 GENERAL

- A. All backfill material shall be approved before use and be free of cinders, ashes, ice, frozen soil, large hard clods, organic debris, or other deleterious items.
- B. Engineered fill materials for all fill areas shall be as required by State Standard Specifications, Section 19-6.
- C. Gravel: Pit run, natural stone; free of shale, clay, organic matter; No. 8 minimum to $\frac{3}{8}$ " maximum size per State Standard Specifications, Section 90-1.02C(4)(a).
- D. Pea Gravel: Natural stone; washed, free of clay, shale, organic matter; $\frac{1}{4}$ " minimum to $\frac{5}{8}$ " maximum size.
- E. Sand: Natural river or bank sand; free of silt, clay, loam, friable or soluble materials, and organic matter, graded in accordance with State Standard Specifications, Section 90-1.02C(4)(C), within the following limits:

<u>Sieve Size</u>	<u>Percent Passing</u>
No. 4	75 - 100
No. 200	0 - 10

- F. Imported sand shall have a Sand Equivalent of 30, per ASTM D 2419.
- G. Class 2 Aggregate Base: Material as specified for $\frac{3}{4}$ " maximum grading in State Standard Specifications Section 26-1.02B, unless otherwise specified.
- H. Permeable material for use in backfilling under, around, and over underdrains; and permeable material for chimney drains, riprap bedding, or other subdrainage purposes shall consist of hard, durable, clean sand, gravel or crushed stone and shall be free from organic materials, clay balls, or other deleterious substances.
 - 1. The percentage composition by weight of permeable materials in-place shall conform to the following gradation when determined by ASTM D-422:

<u>Sieve Size</u>	<u>Percent Passing</u>
1½ inch	90-100
$\frac{3}{4}$ inch	45-75
No. 4	30-45
No. 50	4-10
No. 100	1-3
No. 200	0-2

2.2 MATERIALS FOR TRENCH BACKFILLING

- 1. Furnish required bedding, select backfill and backfill materials listed under the appropriate types of utility line in the sections to which this work relates

2. All fill material will be subject to the approval of the Engineer.

B. Materials used in backfill, as shown in trench details, are defined as follows:

1. Bedding: When rock, unstable material, or wet trench is encountered at the excavated grade for utility installation, bedding is required. Materials shall be predominantly sand and gravel, having a Plasticity Index less than 6.

a. Gradation as follows:

<u>Sieve Size</u>	<u>Percent Passing</u>
½ inch	100
No. 4	50-80
No. 200	10-25

- b. Bedding material shall have a Sand Equivalent of 30, per ASTM D 2419.

2. Bedding may be omitted if, in the opinion of the Engineer, the excavated trench bottom will adequately support and not damage the utility line.

3. Select Backfill: Materials shall be predominantly sand and gravel, having a Plasticity Index less than 6.

a. Gradation as follows:

<u>Sieve Size</u>	<u>Percent Passing</u>
1½ inch	100
No. 4	50-80
No. 40	10-25

- b. Select backfill material shall have a Sand Equivalent of 30 per ASTM D 2419.

4. Backfill: Soils that contain no rock larger than three inches at greatest dimension. If expansive clays are present, such content shall not exceed one-third of the material by volume, and shall be well mixed with non-cohesive soils.

2.3 MATERIALS FOR EMBANKMENTS

- A. Unless otherwise specified, embankment and backfill material shall be as required by State Standard Specifications Section 19, Earthwork.
- B. Embankment material shall contain no rock or hard lumps larger than three inches at greatest dimension. If expansive clays are present, such content shall not exceed one-third of the material by volume, and shall be well mixed with non-cohesive soils
- C. Embankment material for embankments shall be selected to the maximum practical extent from excavation. Deficiency of material, if any, may be made up from other sources, as approved by the Engineer.

PART 3 EXECUTION

3.1 PREPARATION

- A. Identify required lines, levels, contours, and datum.

3.2 MOISTURE CONTROL

- A. Water development, hauling, and application shall be in accordance with State Standard Specifications Section 10-6, Watering.

3.3 EXCAVATION

- A. Excavate the specified areas as shown.
- B. If the Plans require placement of fill prior to pipe, or structure excavation, the fill shall first be constructed to the design grade shown for a distance each side of the pipe or structure of not less than five times the diameter of the pipe or the width of the structure after which the trench shall be excavated and the pipe or structure installed.

3.4 ENGINEERED FILL AND EMBANKMENT CONSTRUCTION

- A. Unless otherwise noted, placement and compaction of engineered fill materials for all fill areas shall be performed according to the provisions of the State Standard Specifications, Section 19-6. Section 19-6.02A shall be amended to say that large rocky material or hard lumps large than three inches in greatest dimension will not be allowed.
- B. Before placing embankment, scarify ground surface to provide ample bond between old and new material, as shown on the Plans. Place embankment material in layers not exceeding eight inches, loose measurement.
- C. Compaction shall be in accordance with State Standard Specifications, Section 19-5. Compact each layer before placing the next layer. As the compaction of each layer progresses, continually level and manipulate to ensure uniform moisture and density. Add water to obtain optimum moisture content. Removal of excess water shall be accomplished through aeration by plowing, blading, disking, or other methods satisfactory to the Engineer.

3.5 EXCAVATION FOR BUILDINGS, TANKS, AND CONCRETE STRUCTURES

- A. See Section 31 23 19.

3.6 TRENCH EXCAVATION AND BACKFILLING

- A. See Section 31 23 17.

3.7 SHORING AND SHEETING

- A. Construct and maintain all shoring, sheeting, and slope layback necessary to protect the excavation, as needed, for the safety of the employees and as required by

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applicable State and Federal laws. Provide suitable barricades for public safety, regardless of trench depth.

3.8 *DEWATERING*

- A. The Contractor shall keep all excavation free from water. Furnish, install, maintain, and operate all necessary pumping and other equipment for dewatering of excavations. The Contractor shall at all times have on the project sufficient pumping equipment for immediate use, including stand-by pumps for use in case other pumps become inoperable.
- B. The dewatering operation shall be continuous, so that the excavated areas are kept free from water during the construction, until backfill has been placed to a sufficient height to anchor the work against possible floatation.
- C. Dewatering devices shall be adequately filtered to prevent the removal of fines from the soil.
- D. Repair any damage caused by the failure of any part of the protective works. Remove temporary protective works when they are no longer needed for dewatering purposes.
- E. Any drain rock required in the trench bottom to convey water or stabilize wet soil shall be included at no extra cost to the Owner.
- F. Provision of dewatering and dewatering equipment shall be considered part of the project with no additional compensation allowed.

3.9 *SURPLUS MATERIAL*

- A. Unless otherwise specified, surplus excavated material shall be used to widen embankments uniformly or to flatten slopes,

3.10 *UNSUITABLE MATERIAL*

- A. Unsuitable material shall be excavated and disposed of in a lawful manner off the project site, all disposal shall be approved by the Engineer prior to initiating the work.

3.11 *SURFACE FINISH WORK*

- A. Paved Areas: Replace removed paving and base course with new material of equal or better quality and of the same texture and color as the adjacent paved areas. Saw cut pavement edges to a true line and broom as needed prior to repaving.
- B. Open Areas: Grade all disturbed areas, blending with adjacent terrain. Minor irregularities will be permitted.
- C. Drainage Ditches: Restore drainage ditches to appropriate line and grade, using approved surface erosion prevention techniques.
- D. Clean Up: Remove all rubbish and excess material for disposal as approved, and leave area in a neat, satisfactory condition.

3.12 *TOLERANCES*

- A. Top Surface of Backfilling: ± 0.10 foot from design grade.

END OF SECTION

SECTION 31 23 17

TRENCHING, BACKFILLING AND COMPACTING

PART 1 GENERAL

1.1 WORK INCLUDED

- A. This section includes material, testing, and installation for trench excavation, backfilling and compacting.

1.2 RELATED WORK

- A. Section 01 33 00 – Submittal Procedures
- B. Section 01 43 00 – Quality Control and Testing
- C. Section 03 30 01 – Cast in Place Concrete
- D. Section 31 11 00 – Clearing and Grubbing
- E. Section 31 23 00 – Earthwork
- F. Section 40 05 00 – Pipe and Fittings

1.3 REFERENCES

- A. ANSI/ASTM C136 – Sieve Analysis of Fine and Coarse Aggregates.
- B. ANSI/ASTM D1557 – Moisture-Density Relations of Soils and Sol-Aggregate Mixture Using 10 lb (4.54 kg) Hammer and 18-inch (457 mm) Drop.
- C. ANSI/ASTM D1556 – Density of Soil and base rock in Place by Sand-Cone Method.
- D. ASTM D 6938 – Density of soil and base rock in place by Nuclear method.
- E. ASTM D 2937 – Density of soil and in place by Tube method.
- F. Section 26 – Aggregate Bases, State Standard Specifications.
- A. *Geotechnical Engineering Investigation* entitled, **GEOTECHNICAL ENGINEERING INVESTIGATION REPORT, TULARE INDUSTRIAL WASTEWATER TREATMENT PLANT DEWATERING** by BSK Associates, dated January 14, 2020.

1.4 SUBMITTALS

- B. Submit plans as required for worker protection against caving ground in excavations. Submittals shall be in accordance with Section 01 33 00.

TRENCHING, BACKFILLING AND COMPACTING
31 23 17-1

1.5 PROTECTION

- A. Protect excavations by shoring, bracing, sheet piling, underpinning, or other methods required to prevent cave-in or loose soil from falling into excavation.
 - 1. Trenches shall have sloping, sheeting, shoring, and bracing conforming with 29CFR1926, Subpart P—Excavations, CAL/OSHA requirements, and the Contract Documents.
- B. Notify Engineer of unexpected subsurface conditions.
- C. Protect bottom of excavations and soil adjacent to and beneath foundations from frost.
- D. When the pipe laying is not in progress, including the noon hours, close the open ends of pipe. Do not allow trench water, animals or foreign material to enter the pipe.

1.6 QUALITY ASSURANCE

- A. Compaction Testing
 - 1. All compaction testing shall be in accordance with Section 01 43 00.

1.7 CONTROL AND DIVERSION OF WATER

- A. General – The Contractor shall furnish or procure all materials and labor required for constructing and maintaining all necessary cofferdams, channels, flumes, drains, sumps, and/or other temporary diversion and protective works and shall furnish, install, maintain, and operate all necessary pumping and other equipment for removal of water from the various parts of the work and for maintaining the foundations and other parts of the work free from water.
- B. Plan – Prior to beginning any work on the removal of water from trenches, the Contractor shall submit for the Engineer's approval a water control plan showing his proposed method for the removal of water from trenches and other parts of the work.
- C. Dispose of the water in a manner that will prevent damage to the adjacent property and in accordance with regulatory requirements.
- D. Do not drain trench water through the pipeline under construction.

1.8 PROJECT CONDITIONS

- A. Underground utilities may exist at this site. Contractor shall take all necessary precautions to protect said utilities. Notify Engineer of any deviation in utility location from that which is shown on the drawings.
- B. Obtain all required permits and licenses before installing utilities and follow the rules and requirements of the authority having jurisdiction.

- C. Arrange construction sequences to provide the shortest practical time that the trenches will be open to avoid hazard to the public, and to minimize the possibility of trench collapse.

PART 2 MATERIALS

See Section 31 23 00.

PART 3 EXECUTION

3.1 GENERAL

- A. Excavation, grading and compaction shall conform to the requirements of Section 19 of the State Standard Specifications.

3.2 INSPECTIONS

- A. Verify stockpiled material has been approved for reuse.
- B. Verify areas to be backfilled are free of debris, snow, ice, or water, and surfaces are not frozen.

3.3 PREPARATION

- A. Identify required lines, levels, contours, and datum.

3.4 AC PAVEMENT AND CONCRETE REMOVAL

- A. Cut bituminous and concrete pavements, regardless of the thickness, curbs, gutters and sidewalks prior to excavation of trenches.
 - 1. Width of material removed shall be at least equal to the required width of the trench at ground surface.
 - 2. Width of material removed shall be as shown on the Plans
 - 3. AC pavement and concrete rubble shall not be used for trench backfill.

3.5 TRENCH EXCAVATION

- A. Excavate the trench to the lines and grades shown on the Drawings for storm sewer, sanitary sewer, water, and other utilities and points of connection, with allowance for pipe thickness, sheeting and shoring if used, and for special bedding.
- B. Paved Areas: Cut existing pavement to full depth to a true line before excavation and maintain the edge suitable for repaving. Pavement removed shall not be used as backfill.
- C. Trenching Guidelines: Excavate the trench to the approximate level of the grade of the utility line to be installed, using adequate trench width and side slopes to safely accommodate worker access.

- D. Shape the trench bottom to ensure uniform contact with the full length of the installed line and remove any sharp-edged materials that might damage the line. Compaction shall be maintained beneath the line.
 - 1. Rocky Trench Bottom: Where ledge rock, hard pan, boulders, or sharp-edged materials are encountered, over excavate a minimum depth of 6 inches below the bottom of the utility exterior wall to permit adequate bedding preparation. The installed utility shall have at least 6 inches of clearance from any rock protrusion.
 - 2. Unstable Trench Bottom: Secure approval of depth of over-excavation and stabilization method. For wet trench construction, use approved method of dewatering through diversion, damming and pumping, well points, or underdrain systems. Dispose of removed fluidized materials as approved. Use bedding material to build a suitable foundation to within 6 inches of finished utility grade, prior to bedding with the specified material. Compact layers to 95 percent of maximum density in not greater than 6-inch layers. Do not proceed with utility installation until wet trench and unstable conditions are corrected to the satisfaction of the Engineer.
- E. Remove areas of sub-grade not readily capable of it-situ compaction.
 - 1. Backfill with Bedding or Select Backfill material and compact to density equal to requirements for subsequent backfill.
- F. Correct unauthorized excavation at no cost to Owner.
 - 1. If the trench is excavated below the required grade, refill any part of the trench excavated below the grade.
 - 2. Place the refilling material over the full width of trench in compacted layers not exceeding eight inches deep to the established grade with allowance for special bedding.
- G. Trench widths in the pipe zone shall be as shown on the drawings. If no details are shown, maximum width shall be 24 inches greater than the pipe outside diameter.
 - 1. Trench width at the top of the trench will not be limited except where width of excavation would undercut adjacent structures and footings. In such case, width of trench shall be such that there is at least two feet between the top edge of the trench and the structure or footing.
- H. Hand trim for bell and spigot pipe joints.
- I. Remove lumped soil, boulders and rock.
- J. Excavation shall not interfere with normal 45 degree bearing splay of foundations.
- K. During trench excavation, place the excavated material only within the working area. Do not obstruct roadways or streets. Conform to federal, state, and local codes governing the safe loading of trenches with excavated material.

L. Foundation stabilization

1. After the required excavation has been completed, the Engineer will inspect the exposed subgrade to determine the need for any additional excavation. It is the intent that additional excavation be conducted in all areas within the influence of the pipeline where unsuitable materials exist at the exposed subgrade. Over excavation shall include the removal of all such unacceptable material that exists directly beneath the pipeline to a width 24 inches greater than the pipe outside diameter and to the depth required.
2. Rock refill used by the Contractor for his convenience will not receive any additional payment.

3.6 TRENCH BACKFILLING AND COMPACTION

- A. Support pipe during placement and compaction of bedding fill.
- B. Backfilling and cleanup work shall be accomplished as sections of pipe or conduit are tested and approved. Vehicular travel through the work site shall be impeded or obstructed as little as possible.
- C. Relative compaction requirements shall be as shown on the Plans but shall not be less than listed in the *Geotechnical Engineering Investigation*.
- A. Compaction: Use vibratory compactors for sands and gravels (non-cohesive soils). Use mechanical tampers for sand and gravel containing a significant portion of fine-grained materials, such as silt and clay (cohesive soils). Hand tamp around pipe or cable to protect the lines until adequate cushion is attained. Puddling or water flooding for consolidation of backfill or compaction by wheel rolling will not be permitted.
- B. Employ a placement method that will not disturb or damage pipe or utilities.
- C. Maintain optimum moisture content of backfill materials to attain required compaction density.
- D. Compact trench backfill to the specified relative compaction. Compact by using mechanical compaction or hand tamping. Do not use high impact hammer type equipment except where the pipe manufacturer warrants in writing that such use will not damage the pipe.
- E. Compact material placed within 12 inches of the outer surface of the pipe by hand tamping only.
1. Carefully place the material around the pipe so that the pipe barrel is completely supported and that no voids or uncompacted areas are left beneath the pipe.
 2. Use particular care in placing material on the underside of the pipe to prevent lateral movement during subsequent backfilling.

- F. After pipe has been bedded, place pipe zone material simultaneously on both sides of the pipe, in maximum 8-inch lifts, keeping the level of backfill the same on each side.
- G. Do not use any axle-driven or tractor-drawn compaction equipment within 5 feet of building walls, foundations, and other structures.
- H. Do not permit free fall of the material until at least two feet of cover is provided over the top of the pipe. Do not drop sharp, heavy pieces of material directly onto the pipe or the tamped material around the pipe. Do not operate heavy equipment over the pipe until at least 3 feet of backfill has been placed and compacted over the pipe.
- I. Remove surplus backfill materials from site.
- J. Leave stockpile areas completely free of excess fill materials.

3.7 UNSUITABLE MATERIAL

- A. Per Section 31 23 00.

3.8 DEWATERING

- A. Per Section 31 23 00.

3.9 TOLERANCES

- A. Per Section 31 23 00.

3.10 SAND CEMENT SLURRY, CONCRETE ENCASEMENT AND THRUST BLOCKS

- A. Place in accordance with the Contract drawings.

END OF SECTION

SECTION 31 23 19 STRUCTURE EXCAVATION & BACKFILLING

PART 1 GENERAL

1.1 WORK INCLUDED

- A. The work of this section consists of excavation and backfill for concrete structures, and preparation of subgrade for concrete flatwork.
- B. Haul, place, rough grade, compact, and finish grade excavated material as engineered fill on those portions of the project site where it is necessary in order to construct the facilities indicated on the Plans.
- C. Dispose of unsuitable material off-site or in designated areas, as directed by the Engineer.

1.2 RELATED WORK

- A. Section 01 43 00 – Quality Control and Testing
- B. Section 03 30 01 – Cast in Place Concrete
- C. Section 31 23 00 – Earthwork
- D. Section 31 22 19 – Finish Grading
- E. Section 31 23 17 – Trenching, Backfilling, and Compacting

1.3 REFERENCES

- A. ASTM D75 – Standard Practice for Sampling Aggregates
- B. ASTM C136 – Sieve Analysis of Fine and Coarse Aggregates.
- C. ASTM D1556 – Density of Soil and base rock in Place by Sand-Cone Method.
- D. ASTM D1557 – Moisture-Density Relations of Soils and Sol-Aggregate Mixture Using 10 lb (4.54 kg) Hammer and 18-inch (457 mm) Drop. (Curve)
- E. ASTM D2937 – Density of soil and in place by Tube method.
- F. ASTM D6938 – Density of soil and base rock in place by Nuclear method.
- G. Section 25 – Aggregate Subbases, State Standard Specifications
- H. Section 26 – Aggregate Bases, State Standard Specifications.
- I. Geotechnical Engineering Investigation entitled, GEOTECHNICAL ENGINEERING INVESTIGATION REPORT, TULARE INDUSTRIAL WASTEWATER TREATMENT PLANT DEWATERING by BSK Associates, dated January 14, 2020.

STRUCTURE EXCAVATION & BACKFILLING
31 23 19-1

1.4 SUBMITTALS

- A. Submit plans as required for worker protection against caving ground in excavations. Submittals shall be in accordance with Section 01 33 00.

1.5 SAMPLES

- A. Submit a 10 pound sample of each type of fill to testing laboratory, in airtight containers.

1.6 QUALITY ASSURANCE

- A. Compaction Testing

All compaction testing shall be in accordance with Section 01 43 00.

- B. Compaction tests will be performed for each lift or layer.
- C. Tests for compaction shall conform to references listed in Part 1.3 of this section
- D. Sample backfill materials per ASTM D 75.
- E. Compaction testing will be performed in accordance with Section 19, State Standard Specifications.
 - 1. Test every 10,000 square feet of engineered fill or aggregate base material placed.
- F. Where compaction tests indicate failure to meet the specified compaction, the Contractor will rework the entire failed area until the specified compaction has been achieved.
- G. The cost of any retests, including time for the Engineer, shall be borne by the Contractor at no additional cost to the project.

1.7 DEFINITION

- A. Unsuitable Material: Unsuitable material is material determined to be
 - 1. Incapable of being compacted to specified density using ordinary methods at optimum moisture content.
 - 2. Too wet to be properly compacted if circumstances prevent satisfactory in-place drying prior to incorporation into the work.
 - 3. Otherwise unsuitable for the planned use.

1.8 PROTECTION

- A. Protect excavations by shoring, bracing, sheet piling, underpinning, or other methods required to prevent cave-in or loose soil from falling into excavation.

- B. Notify Engineer of unexpected subsurface conditions
- C. Protect bottom of excavations and soil adjacent to and beneath foundations from frost.
- D. Grade excavation top perimeter to prevent surface water run-off into excavation.

1.9 CONTROL AND DIVERSION OF WATER

- A. General – The Contractor shall furnish or procure all materials and labor required for constructing and maintaining all necessary cofferdams, channels, flumes, drains, sumps, and/or other temporary diversion and protective works and shall furnish, install, maintain, and operate all necessary pumping and other equipment for removal of water from the various parts of the work and for maintaining the foundations and other parts of the work free from water.

1.10 CLASSIFICATION

- A. Expected material that will be excavated at this site has been identified in the Geotechnical Report.
- B. Regardless of the nature of material excavated, all excavation will be considered unclassified.

1.11 SITE CONDITIONS

- A. Underground utilities may exist at this site. Contractor shall take all necessary precautions to protect said utilities. Notify Engineer of any deviation in utility location from that which is shown on the drawings.

PART 2 PRODUCTS

2.1 SELECT BED AND FILL MATERIALS

- A. Conform to Section 31 23 17.

2.2 SELECT MATERIAL

- A. Gravel: Pit run, natural stone; free of shale, clay, friable materials and debris; graded in accordance with 1½" x ¾" aggregate grading in Section 90-1.02C, State Standard Specifications.
- B. Pea Gravel: natural stone; washed, free of clay, shale, organic matter; ¼ inch minimum to ⅝ inch maximum size.
- C. Sand: Natural river or bank sand; free of silt, clay, loam, friable or soluble materials, and organic matter, graded in accordance with ANSI/ASTM C136 within the following limits:

<u>Sieve Size</u>	<u>Percent Passing</u>
No. 4	75-100
No. 200	0-10

- D. Class 2 Aggregate Base: material as specified for $\frac{3}{4}$ " maximum grading in the State Standard Specifications, Section 26.

2.3 CONCRETE SLURRY

- A. Concrete slurry mix shall be as specified in Section 03 30 01.

2.4 ENGINEERED FILL MATERIAL

- A. Native granular soil materials may be used as engineered fill. Pulverized asphalt concrete or Portland cement concrete may be incorporated into engineered fill provided no rock pockets or voids are produced. Particles larger than three inches shall be removed from trench backfill, particles larger than six inches shall be removed from engineered fill.
- B. All imported fill material placed in structural areas shall consist of predominantly granular soil that is non-expansive, and shall be approved by the Engineer prior to use.
1. The R-value of the imported fill material shall be at least 50.

2.5 GRANULAR BACKFILL/AGGREGATE BASE COURSE

- A. Granular backfill and aggregate base course shall meet the requirements of State Standard Specifications, Section 26, Class 2 aggregate base, $\frac{3}{4}$ inch maximum.
- B. Material from concrete crushing operations may be used as granular backfill provided it meets the above requirements.

2.6 WATER

- A. Water development, hauling, and application shall be in accordance with the State Standard Specifications, Section 10-6, Watering.

PART 3 EXECUTION

3.1 GENERAL

- A. Provide required shoring, sheeting, and slope layback necessary to protect the excavation, as needed, for the safety of the employees and as required by applicable State and Federal laws. Provide suitable barricades for public safety, regardless of trench depth.
- B. Upon completion of excavation and before placing forms or structures, notify the Engineer who will inspect the excavation and may take tests to determine soil-bearing values.

- C. Identify required lines, levels, contours, and datum.
 - 1. Stake and identify the extent of all earthwork operations prior to starting work.
- D. Use suitable material removed from excavation before importing backfill.
- E. Verify that stockpiled fill to be reused is approved by the Engineer.
- F. Verify areas to be backfilled are free of debris, snow, ice, or water, and surfaces are not frozen.

3.2 DEWATERING

- A. The Contractor shall keep all excavation free from water. Furnish, install, maintain, and operate all necessary pumping and other equipment for dewatering of excavations. The Contractor shall at all times have on the project sufficient pumping equipment for immediate use, including stand-by pumps for use in case other pumps become in-operable.
- B. The dewatering operation shall be continuous, so that the excavated areas are kept free from water during the construction, until backfill has been placed to a sufficient height to anchor the work against possible floatation.
- C. Dewatering devices shall be adequately filtered to prevent the removal of fines from the soil.
- D. Repair any damage caused by the failure of any part of the protective works. Remove temporary protective works when they are no longer needed for dewatering purposes.
- E. Provision of dewatering and dewatering equipment shall be considered part of the project with no additional compensation allowed.
- F. Any drain rock required in the trench bottom to convey water or stabilize wet soil shall be included at no extra cost to the Owner.

3.3 EXCAVATION

- A. Carefully excavate to the established lines and grades shown on the drawings, or as revised and approved by the engineer, to provide a firm, uniform, and unyielding foundation for the proposed structures.
- B. The subgrade for all footings, foundations, piers, slabs, walls, and grade beams to receive concrete shall be over-excavated, scarified, conditioned to optimum moisture content, and compacted based on the recommendations in the Geotechnical Investigation and as modified herein:
 - 1. The subgrade for the equipment foundation shall be compacted to 95-percent of the maximum dry density.

- C. All footings, piers, slabs, walls, and grade beams to receive concrete shall be level before placing concrete. All foundations shall rest on firm bearing in undisturbed soil, or on controlled compacted fill.
- D. Where over-excavation is not required all footings, piers, finished walls and grade beams shall be sufficiently large so that forms for concrete may be properly placed, removed, and inspected.
 - 1. Excavation for footings may be made to the net footing size plus two inches if the earth banks are sufficiently stable to remain in position until the concrete is in place and if approved by the Engineer.
- E. If any existing foundations, roots, stumps, debris, waste materials, pipes, or similar items have been removed, the Contractor shall excavate below these portions to solid undisturbed earth and foundations in these areas shall be built to necessary levels.
- F. If soil conditions in excavations are not in accordance with the geotechnical report and seem to indicate that footings need not be carried down as deep as shown, or must be carried deeper, the changes shall be made by the Contractor after approval by the Engineer.
 - 1. Over excavation shall be required a minimum of two feet below top of proposed slab grades under all structures, including but not limited to the tank, tank ring wall, all concrete slabs, etc., unless shown otherwise on the Plans.
 - 2. Engineered fill in over excavated areas shall be import fill material, free from organic materials or deleterious substances.
- G. Common Fill Material (native material) is not acceptable for use as Engineered fill under any structure, tank, tank ring wall, or concrete slab.

3.4 *SURPLUS MATERIAL*

- A. Unless otherwise specified, surplus excavated material shall be used to widen embankments uniformly or to flatten slopes, or it shall be disposed of in a uniform manner along the adjacent roadway around the site or otherwise as approved.
- B. Unless otherwise specified, surplus excavated material shall be used as fill for other areas requiring fill as shown on the Plans. Excess material that is not needed for engineered fill may be disposed of at an off-site spoil area. The location of the off-site spoil area, the limits of the fill area, the depths of fill, and the manner of work shall be as directed by the Engineer.
- C. Stockpile surplus material as shown on the plans and/or as directed by the Engineer
- D. Leave stockpile areas completely free of excess fill materials.

3.5 *UNSUITABLE MATERIAL*

- A. Unsuitable material shall be excavated and disposed of in a uniform manner off the project site, within the Owner's property as approved, however all disposal shall be approved by the Engineer prior to initiating the work.

3.6 *OFF-SITE BORROW AREAS*

- A. Engineered fill material may be obtained from off-site borrow areas, if on-site sources prove to be insufficient.
 - 1. The location of borrow areas, limits of the area to be excavated, and the depths of cut shall be as directed in the field by the Engineer.

3.7 *BACKFILLING*

- A. Unless otherwise shown in the Plans, all backfill shall conform to Section 19-3 of the State Standard Specifications.
- B. Do not place backfill against concrete until concrete has cured sufficiently to accept the load as determined by Section 19-3.03E of the State Standard Specifications.
- C. Place and compact common fill material in continuous layers not exceeding eight inches loose depth.
- D. Employ a placement method so not to disturb or damage pipes or utilities.
- E. Maintain optimum moisture content of backfill materials to attain required compaction density.
- F. Remove surplus materials from site.

3.8 *TOLERANCES*

- A. Top Surface of Backfilling: ± 0.1 foot from design grade.

3.9 *SLURRY CEMENT*

- A. Slurry cement backfill shall be placed and shown on the Drawings and in accordance with State Standards Specifications, Section 19-3.02E.

END OF SECTION

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SECTION 31 23 35

DISPOSAL OF MATERIALS

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Disposal of unsuitable material, concrete, asphalt concrete, rubbish, and other debris, as described below.

1.2 RELATED WORK

- A. Section 01 33 00 – Submittal Procedures
- B. Section 03 30 01 – Cast-In-Place Concrete
- C. Section 31 11 00 – Clearing and Grubbing

1.3 REFERENCES

- A. ASTM D75 – Practice for Sampling Aggregates.
- B. ANSI/ASTM C136 – Sieve Analysis of Fine and Coarse Aggregates.
- C. ANSI/ASTM D1557 – Moisture-Density Relations of Soils and Soil-Aggregate Mixture Using 10 lb (4.54 kg) Hammer and 18-inch (457 mm) Drop.
- D. ANSI/ASTM D1556 – Density of Soil and base rock in Place by Sand-Cone Method.
- E. ASTM D 2922 and D 3017 – Density of soil and base rock in place by Nuclear method.
- F. ASTM D 2937 – Density of soil and in place by Tube method.
- G. Section 26 – Aggregate Bases, State Standard Specifications.
- H. Section 16 – Clearing and Grubbing, State Standard Specifications
- I. Section 17 – Watering, State Standard Specifications
- J. Section 19 – Earthwork, State Standard Specifications
- K. Geotechnical Engineering Investigation entitled, GEOTECHNICAL ENGINEERING INVESTIGATION REPORT, TULARE INDUSTRIAL WASTEWATER TREATMENT PLANT DEWATERING by BSK Associates, dated January 14, 2020.

1.4 SUBMITTALS

- A. Submittals shall be in accordance with Section 01 33 00.

1.5 GENERAL

- A. The Contractor shall be responsible for the cleanup and disposal of waste materials and rubbish. The disposal of waste materials and rubbish shall be in accordance with applicable Federal, State, and local laws and regulations, and with the requirements of this paragraph. Should a conflict exist in the requirements for cleanup and disposal of waste materials, the most stringent requirement shall apply.
- B. The Contractor shall keep records of the types and amounts of waste materials produced, and of the disposal of all waste materials on or off the jobsite.
- C. The cost of disposing of waste materials other than unsuitable materials shall be included in the prices bid in the schedule for other items of work.

PART 2 PRODUCTS

Not Used

PART 3 EXECUTION

3.1 DISPOSAL OF EXCAVATED MATERIAL

- A. All excess excavated material shall be hauled off site to a location selected by the Contractor, meeting the conditions of Paragraph 3.4 below.
- B. All unsuitable material shall be hauled off-site and properly disposed.

3.2 DISPOSAL OF CONCRETE AND A. C. SURFACING

- A. All concrete, A.C. and pavement removed from the project site shall be disposed of at a site obtained by the Contractor and approved by the Owner's Representative. No recyclable material shall be disposed of at any landfill. All disposable recyclable materials shall be disposed in a manner that facilitates recycling. The Contractor shall report quantities of disposed material in a manner that enables the Owner to utilize diverted quantities as diversion credits pursuant to California Integrated Waste Management Act of 1989 (Public Resources Code Sections 40000 et seq.)

3.3 DISPOSAL OF OTHER DEBRIS

- A. All oil cake, wood debris, structure demolition, vegetation and any other debris removed from the project site shall be legally disposed of at a site(s) obtained by the Contractor with prior written permission of the Owner's Representative. Contractor shall identify the proposed Disposal Site(s) at the pre-construction conference. Such Disposal Site(s) shall be a properly licensed and permitted facility pursuant to state and local regulations for purposes of accepting delivery of the respective materials. No recyclable material shall be disposed of at any landfill. All disposable recyclable materials shall be disposed in a manner that facilitates recycling. In addition to the following, a certificate of compliance stating disposal location and manner of disposal of recyclable materials shall be submitted to the Owner's Representative.

1. Disposal of combustible materials shall be by removal from the construction area. Disposal of combustible materials by burning will not be permitted. Disposal of waste materials by burying will not be permitted.
2. Waste materials shall be disposed of or recycled at a State approved disposal or recycle facility. The Contractor shall make any necessary arrangements with private parties, and State and county officials pertinent to locations and regulations of such disposal or recycle facilities, and shall pay any fees or charges required for such disposition.

3.4 *CONTRACTOR'S DISPOSAL SITES*

- A. Contractor shall make arrangements for disposing of the materials at the Disposal Site(s) and pay all costs involved. Arrangements shall include, but not be limited to, obtaining written authorization from the property owner of the Disposal Site(s) and before disposing of any material off the project site, Contractor shall furnish to the Owner's Representative the authorization or a certified copy thereof together with a written release from the property owner absolving the Owner from any and all responsibility in connection with the disposal of material on the property of the Disposal Site(s). Before any material is disposed of on the Disposal Site(s), the Contractor shall obtain written permission from the Owner's Representative to dispose of the material at the location designated in the authorization.
- B. It is expressly understood and agreed that the Owner assumes no responsibility to the Contractor whatsoever by the granting of such permission and Contractor shall assume all risks in connection with the use of the Disposal Site(s). The Contractor is cautioned to make such independent investigation and examination as the Contractor deems necessary to be satisfied as to the quantity and types of materials which may be disposed of on the Disposal Site(s) and the status of any permits or licenses in connection therewith.
- C. Within 24 hours of removing the respective material from the project site for disposal, Contractor shall provide Owner's Representative with a certified copy of the weight slip from the Disposal Site obtained by Contractor upon delivery of such debris, and a certified statement from Contractor identifying the material constituting the debris and that it was disposed of at the Disposal Site (identifying the and name of the owner) in accordance with all laws and applicable regulations promulgated by Federal, State, regional, or local administrative and regulatory agencies.

3.5 *DISPOSAL OF HAZARDOUS WASTE AND MATERIALS*

- A. Materials or wastes, defined as hazardous by 40 CFR 261.3, or by other Federal, State, or local laws or regulations, used by the Contractor or discovered in work or storage areas, shall be disposed of in accordance with these specifications and applicable Federal, State, and local laws and regulations. Unknown waste materials that may be hazardous shall be tested, and the test results shall be submitted to the Owner's Representative for review.
- B. Waste materials known or found to be hazardous shall be disposed of in approved treatment or disposal facilities. Hazardous wastes shall be recycled whenever

possible. A copy of all hazardous waste manifest shall be sent to the Owner's Representative.

- C. Waste materials discovered at the construction site shall immediately be reported to the Owner's Representative. If the waste may be hazardous, the Owner's Representative may order delays in the time of performance or changes in the work, or both. If such delays or changes are ordered, an equitable adjustment will be made in the contract in accordance with the applicable clauses of the contract.
- D. If necessary, the Contractor will be required to conduct an environmental site assessment at the following Contractor use locations:
 - 1. All hazardous waste accumulation areas;
 - 2. All hazardous material and petroleum dispensing and storage areas where the aggregate storage of hazardous materials or petroleum at the site is or has been over 110 gallons.
 - 3. This site assessment shall be performed by a qualified environmental consultant or equivalent and shall document through appropriate analytical sampling that the site is free of the effects of contamination (i.e., contaminant concentrations less than State action cleanup levels).

3.6 *CLEANUP*

- A. The Contractor shall keep work and storage areas free from accumulations of waste materials and rubbish, and before completing the work, shall remove all plant facilities, buildings, including concrete footings and slabs, rubbish, unused materials, concrete forms, and other like materials, which are not a part of the permanent work.
- B. Upon completion of the work, and following removal of construction facilities and required cleanup, work areas shall be regraded and left in a neat manner conforming to the natural appearance of the landscape.

END OF SECTION

SECTION 32 11 23

AGGREGATE BASE

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Furnish, spread, and compact aggregate base in roadways, driveways and other paved areas as shown on the Plans.
- B. The work of this section consists of furnishing and placing aggregate base material and/or lean concrete base materials, and filler if required, on the prepared subgrade.

1.2 RELATED WORK

- A. Section 01 33 00 – Submittal Procedures
- B. Section 31 23 00 – Earthwork
- C. Section 31 22 19 – Finish Grading

1.3 REFERENCES

- A. Section 10-6 – Watering, State Standard Specifications.
- B. Section 26 – Aggregate Bases, State Standard Specifications.
- C. Section 28-2 - Lean Concrete Base, State Standard Specifications.
- D. ANSI/ASTM D75 - Standard Practice for Sampling Aggregates
- E. ANSI/ASTM C136 – Sieve Analysis of Fine and Coarse Aggregates.
- F. ANSI/ASTM D1557 – Moisture-Density Relations of Soils and Soil-Aggregate Mixture Using 10 lb (4.54 kg) Hammer and 18-inch (457 mm) Drop.
- G. ANSI/ASTM D1556 – Density of Soil and Base Rock in Place by Sand-Cone Method.
- H. ASTM D6938 – Density of Soil and Base Rock in Place by Nuclear Method.

1.4 SUBMITTALS

- A. As specified in Section 01 33 00 – Submittal Procedures.
- B. If materials are obtained from a commercial source, submit certification from the supplier certifying that aggregate base course meets the requirements of this section.

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- C. Copies of certified weight tickets for each load of aggregate delivered to the project site.

1.5 QUALITY ASSURANCE

A. Relative Compaction:

1. All costs for initial compaction tests shall be borne by the Owner. All areas that fail to meet the minimum compaction requirements shall be reworked as required by the Engineer and retested until minimum compaction requirements are obtained.
2. The cost of any retests, including time for the Engineer, shall be borne by the Contractor at no additional cost to the project. Testing will be required as directed by the Engineer. Test locations shall be determined by the Engineer upon notification from the Contractor that the grade is ready for tests. Contractor shall be present when samples of bedding, select backfill, and backfill materials are gathered for analysis or testing.

B. Compaction tests will be performed for each lift or layer.

C. Tests for compaction shall conform to references listed in Part 1.3 of this section

D. Sample backfill materials per ASTM D75.

E. Compaction testing will be performed in accordance with Section 19-5 of the State Standard Specifications.

1. Test every 10,000 square feet of engineered fill or aggregate base material placed.

F. The percentage composition by weight shall conform to Class 2 aggregate base determined by Test Method No. Calif. 202, modified by Test Method No. Calif. 905 if there is a difference in specific gravity of 0.2 or more between the coarse and fine portion of the aggregate or between blends of different aggregates.

G. Aggregate base shall also conform to the following quality requirements:

<u>Tests</u>	<u>Test Method Calif. No</u>
R-Value	301
Sand Equivalent	217
Durability Index	229

H. Quality Control shall be under the provisions of Section 01 43 00 – Quality Control.

PART 2 PRODUCTS

2.1 MATERIALS

A. AGGREGATE BASE

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1. Class 2 Aggregate Base, $\frac{3}{4}$ -inch maximum; as per Section 26-1.02B, State Standard Specifications.
 2. Aggregate for Class 2 aggregate base shall be free from organic material and other deleterious substances
- B. RECYCLED AGGREGATE BASE COURSE
1. Recycled aggregate base course shall not be allowed.
- C. LEAN CONCRETE BASE
1. Lean Concrete Base shall conform to the State Standard Specifications, Section 28-4, Lean Concrete Base Rapid Setting.
 2. State Standard Specifications Section 28-4.04 shall not apply.
- D. WATER
1. At the time aggregate base is spread, it shall have a moisture content sufficient to obtain the require compaction. Such moisture shall be uniformly distributed throughout the materials.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

- A. As specified in Section 31 23 00.

3.2 SPREADING

- A. The aggregate base course material shall be deposited and spread to the required compacted thickness by means that will maintain the uniformity of the mixture. The aggregate base course shall be free from pockets of coarse or fine material.
- B. Deliver aggregate base to the area to be paved as a uniform mixture and spread each layer in one operation.
- C. Aggregate base placed at locations which are inaccessible to the spreading equipment shall be spread in two layers by any means to obtain the specified results.
- D. The aggregate shall not be treated with lime, cement or other chemical materials before the Durability Index test has been performed.
- E. The surface of the finished aggregate base at any point shall not vary more than ± 0.05 -foot from the grade shown.

3.3 *PLACING*

- A. If the required compacted depth of the aggregate base course exceeds 6 inches, place course in two or more layers of approximately equal thickness. The maximum compacted thickness of any one layer shall not exceed 6 inches.

3.4 *MIXING*

- A. Mixing shall be in accordance with one of the methods set forth in State Standard Specifications, Section 28-4.03B.

3.5 *MOISTURE CONTROL*

- A. When spread, aggregate base shall have a moisture content sufficient to obtain the specified compaction.

3.6 *SURFACE FINISHING*

- A. Use a smooth steel wheel roller for the final rolling of top surface base course. Water surface and evenly spread loose stones before final rolling. Make minimum of two complete passes over area to embed stones. Correct soft spots developed during rolling.
- B. Compacted aggregate base course surface shall be smooth and free from waves and other irregularities. Unsatisfactory portions of base course shall be corrected, at no additional expense to the Owner.

3.7 *MATERIAL ACCEPTANCE REQUIREMENTS*

- A. Acceptance will be based on periodic samples and tests taken following mixing and before placing.

3.8 *TOLERANCES*

- A. Surface: The finished surface of the base course will be tested with a 10-foot straightedge or other device. The variation between any two contacts with the surface shall not exceed ± 0.05 feet.
- B. Width: Plan dimension, ± 0.10 feet.
- C. Thickness: Plan dimension, ± 0.05 feet.
- D. Any areas not complying with these tolerances shall be reworked to obtain conformity, at no additional expense to the Owner.

3.9 *MAINTENANCE*

- A. Maintain base course in a satisfactory condition until surfaced or until final acceptance.

END OF SECTION

AGGREGATE BASE
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SECTION 40 05 00
PIPE AND FITTINGS

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Furnish, install, and test all water, utility, pipe, fittings, and appurtenances as indicated and as specified.

1.2 RELATED WORK

- A. Section 03 30 01 – Cast-In-Place Concrete
- B. Section 05 05 20 – Bolts, Anchors, Washers and Eyebolts
- C. Section 09 90 00 – Painting and Coating
- D. Section 31 23 00 – Earthwork
- E. Section 31 23 17 – Trenching, Backfilling, and Compacting
- F. Section 40 05 07 – Hangers and Supports for Process Piping
- G. Section 40 05 23 – Valves and Appurtenances
- H. Section 40 20 90 – PVC and CPVC Process and Chemical Piping

1.3 REFERENCES

- A. California Plumbing Code.
- B. American Water Works Association Standards,
- C. ASTM International

1.4 SUBMITTAL REQUIREMENTS

- A. Submit shop drawings in accordance with the General Conditions and Supplementary Conditions.
- B. Submit manufacturer's catalog data. Show manufacturer's model number.
- C. Submit dimensions including wall thickness and materials of construction by reference standard and grade. Submit information on interior and exterior coatings as applicable.

1.5 QUALITY ASSURANCE

- A. All work performed under this section shall meet all recommendations and requirements of AWWA, Uniform Plumbing Code (UPC), NFPA 24, ASTM D2774, and all other applicable national, state, local, standards and regulations.

PART 2 PRODUCTS

2.1 DUCTILE IRON PIPE

- A. General: Ductile iron pipe shall conform to ANSI A21.51 (AWWA C151), and shall be Class 52 unless shown otherwise. Pipe for grooved or flanged joints shall be no less than Class 53.
- B. Joints:
 - 1. Buried pipe and pipe fittings shall have push-on joints or mechanical joints conforming to AWWA C111. Flanged joints, sleeve-type mechanical couplings, and grooved-type couplings shall be used when shown.
 - 2. For push-on joints, shape of pipe ends shall conform to ANSI A21.11 (AWWA C111). Gaskets and lubricant for pipe and fittings shall conform to ANSI A21.11 (AWWA C111).
 - 3. For mechanical joints, dimensional and material requirements for pipe ends, glands, bolts, nuts, and gaskets shall conform to ANSI A 21.11 (AWWA C111). Pipe smaller than 4 inches shall have screwed or grooved joints
 - 4. For flanged joints, ends of pipe and fittings shall be provided with flanges conforming to ANSI A21.15 (AWWA C115), and to ANSI B16.5 for 150 lb. class. Bolts, nuts, and gaskets for flanged connections shall conform to ANSI B18.2.1. For grooved joints, groove specifications shall conform to ANSI/AWWA C606.
- C. Fittings: Fittings with push-on, mechanical joint, grooved joints and flanged ends shall conform to ANSI A21.53 (AWWA C153). Fittings shall have pressure rating of 350 psi for 3"-24" and 250 psi rating for 30"-48" pipe. Fittings shall have cement-mortar lining equivalent to that of the pipe lining.
- D. Coating and Lining: Pipe shall be bituminous seal-coated and cement-mortar lined. The lining shall conform to AWWA C104.
- E. All buried ductile iron pipe shall be encased in an 8 mil lining of polyethylene, installed per AWWA C105.

2.2 STEEL PIPE

- A. General: Steel pipe 12-inches in diameter and smaller shall conform to the requirements of ASTM A53/53M Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless, and shall be Schedule 40.

2.3 POLYVINYL CHLORIDE SCHEDULE PIPE

- A. Refer to Section 40 20 90.

2.4 POLYVINYL CHLORIDE GRAVITY SEWER PIPE (PVC)

- A. PVC gravity sewer pipe 4-inches through 15-inches in diameter shall conform to ASTM D 3034, SDR 26. PVC gravity sewer pipe 18-inches through 36 inches in diameter shall conform to ASTM F679.
- B. Each length of pipe shall be marked with the manufacturers name, nominal size and ASTM designation. Pipe shall be made of PVC plastic having a cell classification of 12454B or 12364B as defined in ASTM D1784 and shall have SDR of 26 and minimum pipe stiffness of 115 PSI according to ASTM Test D2412.
- C. Joints: Pipe shall include an integral bell section with a factory assembled rubber ring gasket conforming to ASTM F477. Joint shall conform to ASTM D3212. Bells shall meet the same strength requirements as that of the pipe.
- D. Fittings: Fittings shall be supplied by the pipe manufacturer and shall meet the strength requirement of the pipe. Integral bells and gaskets shall conform to the requirements for joints in this section. Fittings shall be marked with nominal size, manufacturers name and ASTM designation.
- E. PVC sewer pipe 3 inches to 6 inches, for chemical drain shall conform to ASTM D2729 and D2949. Fittings shall be PVC with socket welded joints and shall conform to ASTM D2949 and ASTM D2665.

2.5 FLEXIBLE COUPLINGS FOR GRAVITY PIPES

- A. Transition type couplings shall be factory manufactured to ensure watertight fit and smooth flow transition at the joint. Couplings shall be made of resilient elastomeric PVC, with all stainless-steel coupling bands including screw and housing. All materials shall be rustproof and unaffected by soil conditions or normal sewer gases, and shall be flexible with earth movement while maintaining seal. Poured concrete collar and similar coupling methods will not be accepted.

2.6 STAINLESS STEEL TUBING

- A. Stainless steel tubing shall be made of Type 316 L stainless steel to the requirements of ASTM A269, of minimum 1/4-inch inside diameter, or as indicated, for the test pressure required. The fittings shall be swage ferrule design of Type 316 L stainless steel, of the double acting ferrule design, providing both a primary seal and a secondary bearing force. Flare bite or compression type fittings are not acceptable.

2.7 COPPER PIPE AND TUBING

- A. Copper tubing shall conform to ASTM B88. Copper tubing for water piping shall have a weight of not less than Type K. Type L copper tubing shall be permitted to be used for water piping when piping is above ground in, or on, a building or underground outside of structures

- B. Fittings:
 - 1. Use soldered joints and fittings in exposed tubing service.
 - 2. Use soldered joints and fittings in buried service.
 - 3. Fittings and joints 3/8" and smaller in exposed service may be of the nut-and ferrule type with flared end connections or compression joint connections.
 - 4. Use threaded joints and fittings in buried and exposed copper and brass piping.
- C. Joints from copper tubing to threaded pipe shall be made by the use of brass adapter fittings. The joint between the copper tubing and the fitting shall be a soldered brazed flared, or pressed joint and the connection between the threaded pipe and the fitting shall be made with a standard pipe size screw joint.
- D. Joints in copper tubing shall be made by the appropriate use of approved copper or copper alloy fittings. Surfaces to be joined by soldering shall be cleaned bright by manual or mechanical means. The joints shall be properly fluxed with an approved type flux and made up with approved solder. Solder and fluxes shall be manufactured to approved standards.
 - 1. Solders and fluxes with a lead content that exceeds two-tenths (0.02) of one (1) percent shall be prohibited in piping systems used to convey potable water.
 - 2. Solder shall be 95-5 (95% tin, 5% antimony) conforming to ASTM B32, Grade Sb5 or silver solder conforming to AMS 4773C.
 - 3. Soldering flux shall comply with ASTM B813.
- E. Only brazing alloys having a liquid temperature above 1000°F (538°C) shall be used.
- F. Nut and Ferrule Fittings: Fittings shall be brass and or the Swagelok type as manufactured by Crawford Fitting Company, utilizing a nut and dual ferrule design to connect to tubing. End connections shall be of the union type.
- G. Unions shall be the same size as the pipe or tube, three part, with copper flare end connections. Unions shall be bronze, ASTM B61 or B62. Unions shall be Mueller H-15400, Jones J-1528, or equal.
- H. Provide an insulating union at the point of transition from copper tubing or piping to ferrous piping.
- I. Buried tubing shall be polyethylene coated, tape wrapped, or encased in a PVC sleeve.

2.8 CHEMICAL PIPING AND TUBING

- A. Unless otherwise noted on the drawings, chemical piping shall be Schedule 80 PVC or CPVC in accordance with Section 40 20 90.

- B. Where tubing inside of EPVC is called out on the drawings.
 - 1. EPVC shall consist of Schedule 80 PVC conduit or pipe utilizing long radius sweep elbows.
 - 2. Chemical dosing tubing shall consist of FDA compliant PVDF tubing with a minimum working pressure of 90 psi at 150°F.
 - 3. Sample tubing shall consist of odorless, tasteless, flexible black polyethylene tubing. Minimum operating pressure shall be 125 psi up to ½-inch in size and shall be ¼ of the burst pressure of the tubing. Tubing shall comply with ASTM D1248, Type I, Class A, Category 4, Grade E and shall be certified to ANSI/NSF Standard 61.
 - 4. Fittings for tubing shall be compression type fittings rated at 150 psi minimum and constructed of a material compatible with the chemical service.

2.9 GROOVED COUPLINGS

- A. Groove dimensions shall conform to AWWA C606.
- B. Grooved couplings for ductile iron shall be Victaulic Style 31;
- C. Flexible grooved couplings for steel pipe shall be Victaulic Style 77 or equal; rigid grooved couplings for steel pipe shall be Victaulic Style 07 or equal. Couplings shall be rigid unless otherwise noted on the drawings.
- D. Grooved - Flanged adapters shall be Victaulic Style 341 for ductile iron pipe and Style 741 for steel pipe or equal.
- E. Grooved coupling for high density polyethylene pipe shall be Victaulic Style 995 or 997 or equal.

2.10 FLANGED JOINTS

- A. Flange shall conform to ANSI B16.5, Class 150.
- B. All steel hardware installed underground shall be coated with a rust preventative, wrapped with 4 mil polyethylene sheeting, and secured with PVC tape.
- C. Gaskets shall be meet the pressure requirements of the adjoining flanges and shall conform to AWWA C-207.
- D. Gaskets for flat face flanges shall be 1/8-inch thick and shall be one of the following materials:
 - 1. Gaskets for non-potable services shall be acrylic or aramid fiber bound with nitrile; Garlock Blue-Gard 3000 or equal. EPDM rubber gaskets, Garlock 98206 or equal, are also acceptable.
 - 2. Gaskets for potable water service shall be NSF/ANSI-61 certified EPDM rubber, Garlock 98206 or equal.

2.11 FLEXIBLE SLEEVE COUPLINGS

- A. Flexible sleeve couplings shall be one of the following, or Engineer approved equivalent:
1. Dresser, Inc., Style 38 for Steel Pipe, and Style 253 Wide- Range for Steel, PVC, Copper, and Cast/Ductile Iron pipe.
 2. Smith Blair, Inc., Series 411 or Wide-Range 461
 3. Romac Industries, Inc., Style 400 for 12" and larger pipe or XR501 Extended Range Coupling, 4" thru 12" pipe size.
- B. Center sleeves shall comply with the following

Nominal Pipe Diameter	Minimum Sleeve Length
6 inch and smaller	Manufacturer's Standard
8 through 14 inch	7 inch
14 inch and larger	10 inch

2.12 FLEXIBLE SPOOL-TYPE EXPANSION COUPLINGS

- A. Flexible rubber coupling shall be flexible joints, which includes a tube, body cover and flanges. The tube shall be a leak proof liner and the body shall consist of fabric and rubber compound, reinforced with steel wire or rings for strength. Flexible rubber coupling shall be either a single arch or double arch construction as indicated in the Plans. Couplings shall have control rods to limit extension and flanges shall have backing rings. Flexible couplings shall have minimum pressure ratings of 100 psi; couplings installed on suction of pumps shall have a minimum vacuum (pressure) rating of 30 inches Hg column.
1. Flexible coupling shall have EPDM liner and cover and shall be manufactured by Proco, Red Valve Company Inc., Metraflex Company or equal.

2.13 MARKER TAPE FOR BURIED PIPING

Not Used.

2.14 TRACER WIRE

Per Section 40 05 97.

2.15 CONCRETE FOR THRUST BLOCKS

- A. As specified in Section 03 30 01 – Cast In Place Concrete. Thrust blocks shall be used only where specifically permitted on the drawings or with pre-approval from the Engineer.

2.16 JOINT RESTRAINT COUPLINGS

- A. Mechanical joint restraint coupling shall be of the type that utilizes the follower gland, and shall consist of several individual lug bolts with gripping mechanism that

prevents the joints from pulling apart. Glands shall be ductile iron conforming to ASTM A536-80, and dimensions shall be compatible to be used with standard mechanical joint fittings for ductile rim pipe. The mechanical restraint joint shall have a minimum working pressure rating equal to that of the pipe with a safety factor of not less than 2. Restrained joints shall have twist off nuts to insure proper installation of restraining grip mechanism. Mechanical joint restrained coupling shall be EBAA, Iron, Inc. MEGALUG; with Mega-Bond coating.; or approved equal. Coating of gland follower body shall be electrostatically applied and heat cured polyester based powder. Wedge assemblies and bolts shall be coated with heat cured fluoropolymer coatings. Restraints shall be designed for the specific type of pipe to be restrained.

- B. Restrained joint fittings shall meet Uni-B-13 for PVC and be FM and UL approved through 12 inch for both ductile iron and PVC.

2.17 FASTENERS

- A. All fasteners shall include washers under both bolt head and nut unless the use of washers is incompatible with the fitting design.
- B. Unless otherwise noted, all bolts, tie rods, and T-bolts used to secure flanges, fittings, and couplings located underground or submerged in liquid shall be Type 316 stainless steel per Section 05 05 20.
- C. Unless otherwise noted, all bolts, tie rods, and T-bolts used to secure flanges, fittings, and couplings located indoors, above grade, and in vaults shall be galvanized carbon steel per Section 05 05 20. Type 304 or 316 stainless steel per Section 05 05 20 shall also be acceptable.

2.18 INSULATING FLANGE SETS

- A. Insulating flange sets shall be provided where indicated on the plans and shall consist of insulating gaskets, insulating sleeves and washers and a steel washer. Insulating sleeves and washers shall be one piece when flange bolt diameter is 1-1/2-inch or smaller and shall be made of acetal resin. For bolt diameters larger than 1-1/2-inch, insulating sleeves and washers shall be 2-piece and shall be made of polyethylene or phenolic. Steel washers shall comply with ASTM A 325. Insulating gaskets shall be full-face.

PART 3 EXECUTION

3.1 HANDLING AND DISTRIBUTION OF MATERIALS

- A. Delivery: Handle pipe carefully to ensure delivery at the project site in sound, undamaged condition. Contractor shall replace damaged pipe at no additional expense to the Owner.
- B. Storage: Do not store materials directly on the ground. Adequately support piping to prevent warping. Use protective covers where pipe may be damaged by direct sunlight.

- C. No more than one week's supply of material shall be distributed in advance of pipe laying operations, unless otherwise approved or required.
- D. Before laying, pipe shall be inspected for cracked, broken, or defective pieces. Such pieces shall be rejected. Pipe shall be carefully lowered into the trench to prevent damage. All dirt or other foreign matter shall be removed from inside the pipe before lowering into the trench.

3.2 COATING

- A. Unless otherwise indicated in Part 2, all pipe and fittings shall be coated in accordance with specification 09 90 00.

3.3 INSTALLATION OF UNDERDRAINS

- A. Perforated pipes shall be laid with the perforations down.

3.4 INSTALLATION OF BURIED PRESSURE PIPING

- A. General: Pipe, fittings, and appurtenances shall be installed in accordance with the manufacturer's instructions and in accordance with the following references as appropriate:
 - 1. Ductile Iron Pipe - AWWA C600
 - 2. Polyvinyl Chloride Pipe and HDPE pipe - AWWA C605.
 - 3. Steel Pipe – AWWA C604
- B. Handling: The pipe shall be protected to prevent entrance of foreign materials during laying operations. When laying is not in progress, open pipe ends shall be protected with a watertight plug or other approved means to exclude water or foreign material.
- C. Alignment:
 - 1. Mains shall be installed to the grades and elevations indicated and shall have a minimum cover of 30-inches from the top of the pipe to existing ground or paved surface unless otherwise indicated.
 - 2. The allowable angle of deflection at any joint shall not exceed the amount recommended by the pipe manufacturer for the particular pipe size used. Deviation of any pipe section from the line and grade indicated shall not exceed 1/2-inch.
- D. Joints:
 - 1. Pipe shall be assembled and joined in accordance with the manufacturer's published instructions for the type of pipe and joint used. All portions of the joints shall be thoroughly cleaned before the sections of pipe are assembled. The ends of each pipe shall abut against the next pipe section in such a manner that there shall be no unevenness of any kind along the bottom half

of the interior of the pipe. Where mechanical joints are used, the pipe shall be marked in such a manner that it can be determined after installation that the pipe is properly seated.

2. Where flexible couplings are used as expansion joints, the ends of the pipes shall be separated 1-inch to allow for expansion. The welded seam at the end of each coupled steel pipe shall be ground smooth for approximately 12-inches. Couplings shall be centered on pipe ends. Runs of pipe containing flexible couplings shall be properly blocked, anchored or tied to the structure to prevent joints from separating.
 3. Mechanical restrained joints shall be installed in accordance with joint manufacturer's instructions and recommendation.
- E. Installation of Marker Tape: Install tape in backfill directly over each pipeline, 24 inches over top of pipe, unless shown otherwise on the Plans. Where utilities are buried in a common trench, identify each line by a separate marker tape. Place tapes directly over the applicable line.

3.5 *THRUST BLOCKS OR MECHANICAL RESTRAINED JOINTS*

- A. Thrust blocks shall be used only where specifically allowed on the drawings or with prior approval by the Engineer.
- B. Place concrete thrust blocks at all tees, elbows, plugs, and other locations where unbalanced forces exist in underground pipe in accordance with details shown. Place blocks between undisturbed ground and fitting to be anchored. Place blocking so that pipe and fittings will be accessible for repairs. Thrust blocks shall be of such size as to give bearing against undisturbed vertical earth banks sufficient to absorb the thrust from line pressure, allowing a maximum earth bearing pressure of 500 pounds per square foot per foot of depth below natural grade or as shown.
- C. Restrained joint fittings may be used in-lieu of thrust blocks, at the discretion of the Engineer. Contractor shall submit shop drawings showing methods of joint restraint for each type of restrained joint fitting to be used including the length of pipe having restrained push-on joints on all pipes which connect to the restrained fitting.
- D. When it is necessary to restrain push-on joints adjacent to restrained fittings, a harness restraint device shall be used. All harnesses shall have a pressure rating equal to that of the pipe on which it is used. Harness assemblies including tie bolts conform to ASTM A536-80.

3.6 *INSTALLATION OF EXPOSED PIPING*

- A. General - Pipe shall be installed as specified, as indicated on the Plans or, in the absence of detail piping arrangement, in a manner acceptable to the Engineer.
- B. Pipe shall be cut from measurements taken at the site and not from the Plans. All necessary provisions shall be taken in laying out piping to provide throughout for expansion and contraction. Piping shall not obstruct openings or passageways.

Pipes shall be held free of contact with building construction so as not to transmit noise resulting from expansion.

- C. The inside of all pipe, valves, and fittings shall be smooth, clean, and free from blisters, loose mill scale, sand, dirt, and other foreign matter when erected. The interior of all lines shall be thoroughly cleaned, to the satisfaction of the Engineer, before being placed in service.
- D. Stuffing box leakage from water sealed pumps shall be contained and not allowed to into storm drains.
- E. Taps for pressure gauge connections on piping and equipment shall be provided with a nipple and a ball type shutoff valve. Drilling and tapping of pipe walls for installation of pressure gauges or switches will not be permitted.
- F. A union shall be provided within 2 feet of each end of threaded end valves unless there are other connections that facilitate easy removal of the valve. Unions shall also be provided in piping at locations adjacent to devices or equipment that may require removal in the future and at locations required by the Plans or other sections of the Specifications.
- G. Provide unions on exposed piping and tubing 3-inches and smaller as follows:
 - 1. At every change in direction (horizontal and vertical).
 - 2. Downstream of valves, 6 to 12 inches.
 - 3. As shown on plans.
- H. In all piping except air piping, insulating fittings shall be provided to prevent contact of dissimilar metals.
- I. Pipe Joints - Pipe joints shall be carefully and neatly made in accordance with the requirements that follow.
 - 1. Threaded - Pipe threads shall conform to ANSI/ASME B1.20.1, NPT, and shall be full and cleanly cut with sharp dies. Not more than three threads at each pipe connection shall remain exposed after installation. Ends of pipe shall be reamed, after threading and before assembly, to remove all burrs.

Threaded joints in plastic piping shall be made up with Teflon thread tape applied to all male threads. Threaded joints in stainless steel piping shall be made up with Teflon thread sealer and Teflon thread tape applied to all male threads. At the option of the Contractor, threaded joints in other piping may be made up with Teflon thread tape, thread sealer, or a suitable joint compound. Thread tape and joint compound or sealers shall not be used in threaded joints that are to be seal welded.

Threaded joints in steel piping for chlorine service shall be made up with Teflon thread tape or paste applied to all male threads.

2. Compression - Ends of tubing shall be cut square and all burrs shall be removed. The tubing end shall be fully inserted into the compression fitting and the nut shall be tightened not less than 1-1/4 turns and not more than 1-1/2 turns past finger tight, or as recommended by the fitting manufacturer, to produce a leak tight, torque-free connection.
3. Flared - Ends of annealed copper tubing shall be cut square and all burrs shall be removed prior to flaring. Ends shall be uniformly flared without scratches or grooves. Fittings shall be tightened as required to produce leak tight connections.
4. Soldered and Brazed - Where solder fittings are specified for lines smaller than 2 inches, joints may be soldered or brazed at the option of the Contractor. Joints in 2 inch and larger copper tubing shall be brazed.
5. Flanged - Flange bolts shall be tightened sufficiently to slightly compress the gasket and effect a seal, but not so tight as to fracture or distort the flanges. A plain washer shall be installed under the head and nut of bolts connecting plastic pipe flanges. Anti-seize thread lubricant shall be applied to the threaded portion of all stainless steel bolts during assembly. Connecting flanges shall have similar facings, i.e., flat or raised face.
6. Welded - Welding shall conform to the specifications and recommendations contained in the "Code for Pressure Piping", ANSI B31.1.
7. Grooved Couplings - Grooves for grooved couplings shall be cut with a specially designed grooving tool. Grooves cut in steel pipe shall conform to flexible grooving dimensions as set forth in AWWA C606, and shall be clean and sharp without burrs or check marks.

3.7 ACCEPTANCE TESTS AND INSPECTION FOR GRAVITY PIPING

A. General.

1. All testing and inspection shall be performed after final backfill and compaction operations are complete. If the Contractor so desires, he may pretest the lines at his own expense, but final testing must be performed after compaction requirements have been approved.
2. If any of the tests or inspections covered in this section indicates that sewers require repair, then after repairs are complete, all testing and inspection shall be performed again. The cost of any retests, including time for the Engineer, shall be borne by the Contractor at no additional cost to the project.
3. Prior to testing, all lines shall be thoroughly cleaned by flushing, and shall have passed a Wayne ball of appropriate size. Contractor is to submit to the Engineer a detailed procedure on protecting the existing sewer system from contaminants during the flushing operation.

B. Mandrel

1. All sections of completed gravity pipe main lines shall be tested to assure that no potential obstructions are present in the lines. A rigid mandrel with a circular cross section having a diameter not less than 95% of the specified pipe diameter shall pass through the pipe without resistance.

C. Low-Pressure Air Test

1. Supply air to the test section slowly. A constant pressure of 3.5 psig shall be reached and maintain internal pressure of at least 3.0 psig for at least five (5) minutes.
2. After the stabilization period, disconnect the air supply. A pressure loss of 0.5 psig is used to compute the allowable pressure loss using the following formula.
3. The minimum allowable time in minutes for such a pressure drop is determined from the formula $T_{\min} = 0.000183D^2L$, where:
 - a. D = Nominal inside diameter of pipe (inches)
 - b. L = Length of pipe test section (feet)
4. Regardless of the formula, the minimum time allowed for pressure drop shall be eight (8) minutes.
5. The pressure gage for monitoring the air pressure shall have a minimum division of 0.10 psi increments.
6. A valid test is when the air pressure is released from the opposite end of the inlet air entry connection with an air release apparatus outlet connection.
7. Adjustment of Pressure for Groundwater. Should the pipe section being tested lie below the local groundwater table, the test pressures shall be raised in proportion to the depth of the centerline of the pipe below the water table. Additional pressure (beyond the 3.5 psig specified above) shall be added at the rate of 0.433 psig per foot of depth below groundwater.

D. Video

1. Video inspection shall be performed on all new sewer mains. Video inspections shall be paid for by the Contractor and shall be completed prior to the final acceptance of the improvements.
2. The inspection shall be in color, and shall be recorded on VHS-format 1/2" tape or DVD, which shall become the property of the Owner.
3. The Engineer shall be the sole judge as to the acceptability of construction revealed by such inspection.
4. Within 24 hours prior to testing, all lines shall be thoroughly flushed with water to assist camera in the identification of low areas.

3.8 ACCEPTANCE TESTS FOR BURIED PRESSURE PIPING

A. General.

1. All testing and inspection shall be performed after final backfill and compaction operations are complete. If the Contractor so desires, he may pretest the lines at his own expense, but final testing must be performed after compaction requirements have been approved.

B. In general, tests shall be conducted in accordance with AWWA C600 and C651 except as otherwise herein specified.

C. All newly installed sections of buried pressure piping shall be pressure and leakage tested as described herein.

1. For buried pressure pipelines, tests shall be made on two or more valved sections not to exceed 2,500 feet in length. The Contractor shall furnish all necessary equipment, material and labor required.
2. Tests shall be made after the trench has been backfilled and compacted, but not until at least 5 days have elapsed since any thrust blocks in the section have been poured.
3. The pipe shall be filled with water and all air expelled from section being tested. A test pressure equal to 1.5 times the design pressure, of the pipe measured at the point of lowest elevation pressure, or 100 psi, whichever is greater, shall be applied.
4. The test pressure in the line shall be maintained for a period of 2 hours. Test pressure shall be maintained within 5 psi during the test period by adding water as required. The water required to maintain test pressure shall be measured by means of a graduated barrel, drum, or similar device at the pump suction or through a meter.

Allowable leakage at the specified test pressure shall not exceed the amounts allowed by AWWA C600, $L = \frac{SD\sqrt{P}}{148,000}$

Where:

L = Testing allowance in gallon per hour.

S = Length of pipe tested in feet.

D = Nominal diameter of the pipe in inches.

P = Average test pressure during the hydrostatic test, in pounds per sq. inch.

Hydrostatic testing allowance per 1,000 ft. of pipeline in gph.

PSI	4"	6"	8"	10"	12"	14"	16"	18"	20"	24"
200	0.38	0.57	0.76	0.96	1.15	1.34	1.53	1.72	1.91	2.29
175	0.36	0.54	0.72	0.89	1.07	1.25	1.43	1.61	1.79	2.15
150	0.33	0.50	0.66	0.83	0.99	1.16	1.32	1.49	1.66	1.99
125	0.30	0.45	0.60	0.76	0.91	1.06	1.21	1.36	1.51	1.81
100	0.27	0.41	0.54	0.68	0.81	0.95	1.08	1.22	1.35	1.62

5. Should testing disclose any visible leaks or leakage greater than that allowed, the defective joints or pipe shall be located, repaired, and re-tested until satisfactory. The cost of any retests, including time for the Engineer, shall be borne by the Contractor at no additional cost to the project.

3.9 ACCEPTANCE TEST FOR EXPOSED PIPING

- A. Pipe to be Tested - All new installed piping sections shall be pressure and leakage tested as specified herein.
- B. Pressure Testing - After the section of line to be tested has been filled with water or other test media, the test pressure shall be applied and maintained without interruption for 2 hours plus any additional time required for the Engineer to examine all piping undergoing the test and for the Contractor to locate all defective joints and materials.
 1. Test medium shall be potable water for potable water piping; all other piping may be tested using plant water subject to Engineer's approval.
 2. Pipe system shall be tested at 1-1/2 times the operating pressure, or 100 psi, whichever is greater, using the appropriate test fluid medium.
 3. All piping shall be tight and free from leaks. All pipe, fittings, valves, pipe joints, and other materials that are found to be defective shall be removed and repaired or replaced with new and acceptable material, and the affected portion of the piping be retested until satisfactory. The cost of any retests, including time for the Engineer, shall be borne by the Contractor at no additional cost to the project.

Compressed air or gas under pressure shall not be used to test plastic piping unless specifically recommended by the pipe manufacturer.

Leakage may be determined by loss of pressure, soap solution, chemical indicator, or other positive and accurate method acceptable to the Engineer. All fixtures, devices, or other accessories which are to be connected to the lines and which would be damaged if subjected to the specified test pressure shall be disconnected

and ends of the branch lines plugged or capped as required during the testing procedures.

END OF SECTION

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SECTION 40 05 07
HANGERS AND SUPPORTS FOR PROCESS PIPING

PART 1 GENERAL

1.1 WORK INCLUDED

- A. All pipe hangers, brackets, supports and accessories for newly installed piping as specified and indicated in the Contract Documents.
- B. All labor, materials, equipment and incidentals necessary and required for their completion.
- C. Concrete and fabricated steel supports shall be as indicated or specified in other sections or, in the absence of such requirements, as permitted by the Engineer.

1.2 RELATED WORK

- A. Section 03 30 01 – Cast-in-Place Concrete
- B. Section 09 90 00 – Painting and Coating
- C. Section 40 05 00 – Pipe and Fittings
- D. Section 40 05 23 – Valves and Appurtenances

1.3 REFERENCES

- A. Seismic design requirements in applicable codes and regulations.

1.4 QUALITY ASSURANCE

- A. Except as modified or supplemented herein, all pipe supports shall comply with the applicable provisions of ANSI/MSS SP-58 AND MSS SP-69.
- B. In certain locations, pipe supports, anchors, and expansion joints have been indicated on the drawings, but no attempt has been made to indicate every pipe support, anchor, and expansion joint. It shall be the Contractor's responsibility to provide a complete system of pipe supports, to provide expansion joints, and to anchor all piping, in accordance with the requirements set forth herein. Additional pipe supports may be required adjacent to expansion joints, couplings, or valves.

1.5 SUBMITTALS

- A. Submittals shall be in accordance with the General Conditions and Section 01 33 00.
- B. Data shall include a listing of the intended use and general location of each item submitted.

1.6 DELIVERY, STORAGE AND HANDLING

- A. All pipe support materials shall be packaged as necessary to ensure delivery in satisfactory condition.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Unless otherwise specified or indicated on the drawings, pipe supports shall be fabricated of manufacturer's standard materials and provided with manufacturer's standard finish.
- B. Pipe support types and application shall comply with Schedule I in paragraph 3.2.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Design Criteria
 - 1. Pipe supports shall be manufactured for the size and type of pipe to which they are applied. Strap hangers will not be acceptable. Threaded rods shall have sufficient threading to permit the maximum adjustment available in the support item.
 - 2. All piping shall be rigidly supported and anchored so that there is no movement or visible sagging between supports.
 - 3. Anchorage shall be provided to resist thrust due to temperature changes, changes in diameter or direction, or dead ending. Anchors shall be located as required to force expansion and contraction movement to occur at expansion joints, loops or elbows, and as required to prevent excessive bending stresses and opening of mechanical couplings. Anchorage for temperature changes shall be centered between elbows and mechanical joints used as expansion joints. Pipe supports shall be designed to comply with the applicable seismic requirements in accordance with the seismic design requirements section.

2.3 DIMENSIONS

- A. Unless closer spacing is indicated on the drawings, the maximum spacing for pipe supports and expansion joints shall be as scheduled in Schedule II at the end of this section.

2.4 STRUCTURAL DESIGN

- A. Design loads for inserts, brackets, clamps, and other support items shall not exceed the manufacturer's recommended loads.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Approved anchors shall be used to fasten supports to concrete or masonry. Unless otherwise indicated on the drawings or permitted by the Engineer, piping shall be supported so that the closest distance from pipe wall or insulation covering is at least 1-1/2 inches from the face of walls and at least 3 inches below ceilings.
- B. Contact between dissimilar metals, including contact between stainless steel and carbon steel, shall be prevented. Those portions of pipe supports which contact dissimilar metals shall be rubber or vinyl coated.

3.2 SCHEDULES

- A. SCHEDULE I: Pipe Support Types and Application Schedule:

<u>Description or Location</u>	<u>MSS SP-69</u> (Note 1)	<u>Other</u>
<u>Hangers</u>		
2-1/2 inch and smaller pipe:		
J-style	5	Elcen "90", Fee & Mason "210", Unistrut "J Hangers", or equal.
clevis	1	Elcen "12B", Fee & Mason "105", ITT Grinnell "65", or equal.
3-inch through 10-inch pipe:		
clevis	1	Elcen "12", Fee & Mason "239", ITT Grinnell "260" for steel pipe; Elcen "12C", Fee & Mason "104", ITT Grinnell "590" for cast iron pipe, or equal.
<u>Concrete Inserts, steel:</u>		
12-inch and smaller pipe	18	Channel 12 ga, galv. 1-5/8" x 1-3/8", min. 8 inches long, anchor lugs on 4" centers, at least three lugs, end caps, and filler strip.
<u>Wall Supports and Frames, steel :</u>		
12-inch and smaller pipe:		
brackets	32, 33	---
prefabricated channels	---	12 ga galv., 1-5/8" x 1-5/8", with suitable brackets and pipe clamps.
offset pipe clamp, (1-1/2 inch and smaller pipe)	---	Galv., 1-1/4" x 3/16" steel with 3/8" bolts.

HANGERS AND SUPPORTS FOR PROCESS PIPING
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<u>Description or Location</u>	<u>MSS SP-69</u> (Note 1)	<u>Other</u>
offset pipe clamp, (2-inch to 3-1/2 inch pipe)	---	Galv., 1-1/4" x 1/4" steel, with 3/8" bolts.
<u>Floor Supports</u> , steel or cast iron:		
6-inch and small pipe	37 with base	---
8-inch through 24-inch pipe	38 with base	--

B. SCHEDULE II: Spacing Schedule

- Distance between supports shall not be more than that recommended by the pipe manufacturer.
- Distance between supports shall not be more than that shown on the drawings.
- Additional supports shall be added as required to prevent visible bowing of pipe.
- In addition to the spacing requirements listed above, the distance between supports shall not be more than listed in the following schedule.

Type of Pipe	Pipe Support Max Spacing, ft	Max Run Without Expansion Joint, Loop. or Bend, ft	Expansion Joint Max Spacing, ft	Type of Expansion Joint
Ductile Iron, 4" and larger	15	80	80	Note 1
Steel for all services:				
1-1/4-inch and smaller	7	30	100	Note 1
1-1/2 to 4-inch	10	30	100	Note 1
Over 4 inch	15	80	80	Note 1
PVC, Schedule 40				
Smaller than 3"	4	20	60	Note 1

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Industrial WWTP Dewatering Project

Type of Pipe	Pipe Support Max Spacing, ft	Max Run Without Expansion Joint, Loop. or Bend, ft	Expansion Joint Max Spacing, ft	Type of Expansion Joint
3" and larger	6	20	60	Note 1
PVC Schedule 80				
Smaller than 3"	5	20	60	Note 1
3" and larger	7	20	60	Note 1

Notes:

1. Expansion joint not required in straight run of pipe if overall length does not exceed the maximum run specified in schedule.

END OF SECTION

HANGERS AND SUPPORTS FOR PROCESS PIPING
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SECTION 40 05 23

VALVES AND APPURTENANCES

PART 1 GENERAL

1.1 WORK INCLUDED

- A. This section includes materials, testing, and installation of manually operated valves including gate, butterfly, ball, hose bibbs, solenoid, and vacuum breakers.

1.2 RELATED WORK

- A. Section 01 33 00 – Submittal Procedures
- B. Section 09 90 00 – Painting and Coating

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM)
- B. American Water Works Association (AWWA)

1.4 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions and Section 01 33 00.
- B. Submit manufacturer's catalog data and detail construction sheets showing all valve parts. Describe each part by material of construction, specification (such as AISI, ASTM, SAE, or CDA), and grade or type.
- C. Show valve dimensions including laying lengths. Show port sizes. Show dimensions and orientation of valve actuators, as installed on the valves. Show location of internal stops for gear actuators. State differential pressure and fluid velocity used to size actuators. For worm-gear actuators, state the radius of the gear sector in contact with the worm and state the handwheel diameter.
- D. Show valve linings and coatings. Submit manufacturer's catalog data and descriptive literature.
- E. Submit six copies of a report verifying that the valve interior linings and exterior coatings have been tested for holidays and lining thickness. Describe test results and repair procedures for each valve. Do not ship valves to project site until the reports have been returned by the Owner's Representative and marked "Resubmittal not required."
- F. For butterfly valves, show the clear diameter or size of the port. Show the actual area of the port as a percentage of the area as calculated for the nominal valve size.

PART 2 PRODUCTS

2.1 GENERAL

- A. Valves are identified in the drawings by size, category and type number. For example, a callout in the drawings of 6" Type-1 butterfly valve refers to Type-1 valve in the butterfly valve category in these specifications, which is a Class 125 rubber seated butterfly valve.
- B. Install valves complete with operating handwheels or levers, chainwheels, extension stems, floor stands, gear actuators, operating nuts, chains, and wrenches required for operation.
- C. Valves shall have the name of the manufacturer and the size of the valve cast or molded onto the valve body or bonnet or shown on a permanently attached plate.

2.2 VALVE ACTUATORS

- A. Provide lever or wrench actuators for exposed valves 6 inches and smaller. For larger valves, provide handwheels.
- B. Where manually operated valves (size 4 inches and larger) are installed with their centerlines more than 6 feet 9 inches above the floor, provide chainwheel and guide actuators.
- C. Provide 2-inch AWWA operating nuts for buried and submerged valves.
- D. Provide enclosed gear actuators on butterfly valves 8 inches and larger, unless electric motorized valve actuators are shown in the drawings. Gear actuators for valves 8 through 20 inches shall be of the worm and gear, or of the traveling nut type. Gear actuators for valves 24 inches and larger shall be of the worm and gear types. Gear actuators for motorized valves shall be of the worm and gear type, regardless of size.
- E. Provide gear actuators on gate valves 14 inches and larger, unless electric motorized valve actuators are shown in the drawings. Gear actuators shall be of the bevel or spur gear type. Provide grease case. Gearing shall comply with AWWA C500.
- F. Design gear actuators assuming that the differential pressure across the plug, gate, or disc is equal to the test pressure of the connecting piping and assuming a fluid velocity of 16 fps for valves in liquid service and 80 fps for valves in air or gas service and a line fluid temperature range of 33°F to 125°F unless otherwise required in the detailed valve specifications. Size actuators using a minimum safety factor of 1.5 for valves in open/close service and 2.0 in modulating service.
- G. Gear actuators shall be enclosed, oil lubricated, with seals provided on shafts to prevent entry of dirt and water into the actuator. Gear actuators for valves located above ground or in vaults and structures shall have handwheels. The actuators for valves in exposed service shall contain a dial indicating the position of the valve disc

or plug. Gear actuators for buried or submerged valves shall have 2-inch-square AWWA operating nuts.

- H. For buried or submerged service or valves installed in buried vaults, provide watertight shaft seals and watertight valve and actuator cover gaskets. Provide totally enclosed actuators designed for buried or submerged service.
- I. Traveling nut and worm and gear actuators shall be of the totally enclosed design so proportioned as to permit operation of the valve under full differential pressure rating of the valve with a maximum pull of 40 pounds on the handwheel or crank. Provide stop limiting devices in the actuators in the open and closed positions. Actuators shall be of the self-locking type to prevent the disc or plug from creeping. Design actuator components between the input and the stop-limiting devices to withstand without damage a pull of 200 pounds for handwheel or chainwheel actuators and an input torque of 300 foot-pounds for operating nuts when operating against the stop.
- J. Handwheel diameters for traveling nut actuators shall not exceed 8 inches for valves 12 inches and smaller and shall not exceed 12 inches for valves 20 inches and smaller.
- K. Design actuators on buried valves to produce the required torque on the operating nut with a maximum input of 150 foot-pounds.
- L. Valve actuators, handwheels, or levers shall open by turning counterclockwise.

2.3 CAST IRON VALVE BOXES AND RISERS

- A. Valve boxes shall be Christy G5 with Christy Iron Covers or equal unless otherwise shown on the Drawings.
- B. Risers shall be 8-inch nominal diameter PVC pipe conforming to AWWA C900.

2.4 INDICATOR POSTS

- A. Indicator posts for buried gate valves in fire protection service shall be UL listed, FM approved for use on valves of sizes 4 through 12 inches. Provide a target or sign visible through a window on both sides of the post that indicates the open or shut position of the gate valve. Working parts shall be fully enclosed for weather protection. Body shall be cast or ductile iron. Provide post extension if trench is deeper than can be served by manufacturer's standard post. Coat buried portion of indicator posts per Section 09 90 00, System No. 21. Products: Nibco NIP-1, Stockham Figure G-951, or equal.

2.5 EXTENSION STEMS FOR BURIED AND SUBMERGED VALVE ACTUATORS

- A. Where the depth of the valve is such that its centerline is more than 4 feet below grade, provide operating extension stems to bring the operating nut to a point 6 inches below the surface of the ground and/or box cover. Where the valve is submerged, provide operating extension stems to bring the operating nut to 6 inches above the water surface. Extension stems shall be Type 316 stainless steel, solid

core, and shall be complete with 2-inch-square operating nut. The connections of the extension stems to the operating nuts and to the valves shall withstand without damage a pull of 300 foot-pounds.

- B. Extension stem diameters shall be as tabulated below:

Valve Size (inches)	Minimum Extension Stem Diameter (inches)
2	3/4
3, 4	7/8
6	1
8	1 1/8
10, 12	1 1/4
14	1 3/8
16, 18	1 1/2
20, 24, 30, 36	1 3/4
42, 48, 54	2

2.6 FLOOR STANDS, EXTENSION STEMS, AND EXTENSION STEM SUPPORT BRACKETS

- A. When required by the installations, provide floor stands and extension stems for operation of valves. Floor stands shall be of the nonrising stem, indicating type, complete with steel extension stems, couplings, handwheels, stem guide brackets, and special yoke attachments as required by the valves and recommended and supplied by the stand manufacturer. Floor stands shall be cast-iron base type: Clow, Figure F-5515; Bingham and Taylor; Stockham; or equal. Handwheels shall turn counterclockwise to open the valves.
- B. Provide Type 316 stainless steel anchor bolts.
- C. Provide steel extension stems for valves in exposed service. Provide Type 316 stainless steel stems for valves in submerged service.
- D. Provide adjustable stem guide brackets for extension stems. The bracket shall allow valve stems to be set over a range of 2 to 36 inches from walls. Provide bushings drilled to accept up to 2-inch-diameter stems. Base, arm, and clamp shall be ductile iron. Coat ductile iron components with fusion-bonded epoxy per Section 09 90 00. Bushing shall be bronze (ASTM B584, Alloy C86400 or C83600). Bolts, nuts, screws, and washers (including wall anchor bolts) shall be Type 316 stainless steel. Provide slots in the bracket to accept 3/4-inch bolts for mounting the bracket to the wall. Products: Trumbull Industries, Inc., Adjustable Stem Guide or equal.

2.7 CHAINWHEELS AND GUIDES

- A. Chainwheels and guides shall be Clow Figure F-5680, DeZurik Series W or LWG, Stockham, or equal. Chainwheels and guides shall be galvanized iron or steel. Chains shall extend to within 4 feet of the operating floor. Chains shall be galvanized steel.

2.8 BOLTS AND NUTS FOR FLANGED VALVES

- A. Bolts and nuts for flanged valves shall be as described in Section 40 05 00.

2.9 GASKETS FOR FLANGES

- A. Gaskets for flanged end valves shall be as described in Section 40 05 00.

2.10 PAINTING AND COATING

- A. Coat metal valves located above ground or in vaults and structures the same as the adjacent piping. If the adjacent piping is not coated, then coat valves per Section 09 90 00. Apply the specified prime coat at the place of manufacture. Apply intermediate and finish coats in field.
- B. Coat buried metal valves at the place of manufacture per Section 09 90 00, System No. 7.
- C. Coat submerged metal valves, stem guides, extension stems, and bonnets at the place of manufacture per Section 09 90 00, System No. 1.
- D. Line the interior metal parts of metal valves 4 inches and larger, excluding seating areas and bronze and stainless steel pieces, per Section 09 90 00, System No. 1. Apply lining at the place of manufacture.
- E. Alternatively, line and coat valves with fusion-bonded epoxy.
- F. Coat floor stands per Section 09 90 00.
- G. Test the valve interior linings and exterior coatings at the factory with a low-voltage (22.5 to 80 volts, with approximately 80,000-ohm resistance) holiday detector, using a sponge saturated with a 0.5% sodium chloride solution. The lining shall be holiday free.
- H. Measure the thickness of the valve interior linings per Section 09 90 00. Repair areas having insufficient film thickness per Section 09 90 00

2.11 PACKING, O-RINGS AND GASKETS

- A. Unless otherwise stated in the detailed valve specifications, packing, O-rings, and gaskets shall be one of the following nonasbestos materials:
 - 1. Teflon.
 - 2. Kevlar aramid fiber.

3. Acrylic or aramid fiber bound by nitrile. Products: Garlock "Bluegard," Klinger "Klingersil C4400," or equal.
4. Buna-N (nitrile).

2.12 RUBBER SEATS

- A. Rubber seats shall be made of a rubber compound that is resistant to free chlorine and monochloramine concentrations up to 10 mg/L in the fluid conveyed.

2.13 VALVES

- A. Ball Valves:

1. Type 2—Full Port Threaded Bronze Ball Valves 2 Inches and Smaller (Low Lead):

Ball valves, 2 inches and smaller, for water service shall have a pressure rating of at least 600 psi WOG at a temperature of 100°F. Provide full port ball and body design. Valves shall comply with MSS SP-110. Materials of construction shall be as follows:

Component	Material	Specification
Body	Bronze	ASTM B584, Alloy C89836
Ball	Bronze	ASTM B584, Alloy C89836 or Alloy C27450, chromium plated
Ball retainer	Bronze	ASTM B584, Alloy C89836 or ASTM B371, Alloy C69430
Stem	Bronze	Alloy C27450
Seats	Reinforced Teflon	—

Bronze alloys having a maximum lead content of 0.25%, a maximum zinc content of 7.0%, and a minimum copper content of 80% may be substituted for the bronze alloys specified above. Valves shall have threaded ends (ASME B1.20.1), nonblowout stems, and have plastic-coated lever actuators.

Valves shall be Apollo 77CLF Series or equal.

2. Type 6—True Union CPVC Ball Valves:

Ball valves, 2 inches and smaller, for chemical or water service shall be Schedule 80 full bore design, true union type. Where used in potable water service, the valve shall be ANSI/NSF-61 certified. Valves shall be constructed from CPVC Type IV, ASTM D 1784 Cell Classification 23447 and rated for a pressure of 150 psi at a temperature of 105°F and 235 psi at a temperature of 73°F. All O-rings shall be EPDM or FKM as required for the compatibility with the chemical service and seats shall be constructed of PTFE. All valve components shall be replaceable. Valves for sodium

hypochlorite service shall include vented balls. Valves shall be manufactured by Spears Manufacturing, Asahi, Plast-O-Matic, Harrington or equal.

3. Type 7—True Union PVC Ball Valves:

Ball valves, 3 inches and smaller, for chemical or water service shall be Schedule 80 full bore design, true union type. Where used in potable water service, the valve shall be ANSI/NSF-61 certified. Valves shall be constructed from PVC Type I, ASTM D 1784 Cell Classification 12454 and rated for a pressure of 150 psi at a temperature of 105°F and 235 psi at a temperature of 73°F. All O-rings shall be EPDM or FKM as required for the compatibility with the chemical service and seats shall be constructed of PTFE. All valve components shall be replaceable. Valves for sodium hypochlorite service shall include vented balls. Valves shall be manufactured by Spears Manufacturing, Asahi, Plast-O-Matic, Harrington or equal.

B. Hose Valves, Hose Bibbs:

1. Type 3—Brass or Bronze Angle Hose Valves 1 1/2 and 2 1/2 Inches (UL Listed):

Angle-type hose valves of sizes 1 1/2 and 2 1/2 inches shall be UL approved complying with UL 668, cast or forged brass or bronze, with handwheel. Inlet threads shall be female NPT. Outlet hose threads shall be male national standard fire hose (MNST). Minimum pressure rating shall be 300 psi. Provide caps with chains for the outlet. Products: Fire Protection Products, Inc. Series 07, National Fire Equipment, Guardian Fire Equipment Model 5000, NIBCO T-331-HC, American Fire Hose and Cabinet Series 400, or equal.

2. Type 4—Bronze Hose Bibbs:

Hose bibbs of size 1/2 inch, 3/4 inch, and 1 inch shall be all bronze (ASTM B62 or ASTM B584, Alloy C83600) with rising or nonrising stem, composition disc, bronze or malleable iron handwheel, and bronze stem (ASTM B99, Alloy C65100; ASTM B371, Alloy C69400; or ASTM B584, Alloy C87600). Packing shall be Teflon or graphite. Valves shall have a pressure rating of at least 125 psi for cold-water service. Threads on valve outlet shall be American National Standard fire hose coupling screw thread (ASME B1.20.7). Provide atmospheric vacuum breaker conforming to ASSE Standard 1011 and IAPMO code.

C. Plug Valves:

1. Type 1 – Eccentric Plug Valves 2-1/2 through 20 inches:

Eccentric plug valves shall be of the non-lubricated eccentric type with cast iron bodies, resilient faced plugs, or shall include replaceable, resilient seat in the body. Except as otherwise indicated, all valves for sizes 4-inch and larger shall have worm gear operators, nickel or stainless steel seats, and ANSI 125 psi flanged or grooved ends. Valves 2-1/2 inches and smaller shall have

operating levers, nickel or stainless steel seats, and threaded ends with resilient facing suitable for the intended service. Submerged and buried valves shall be equipped with worm-gear operators, lubricated and sealed to prevent entry of dirt and water into the operator. Shaft bearings shall be stainless steel furnished with permanently-lubricated bearing surfaces. Operators shall clearly indicate valve position. Valves up to and including 20 inches in size shall have an unobstructed port area of not less than 80 percent of full pipe area, and not less than 70 percent for larger valves. Eccentric plug valves shall have a pressure rating of not less than 150 psi water, oil, or gas (WOG) service and bubble-tight shut-off. Valves shall be coated per Section 09 90 00 System 7 or with fusion bonded epoxy.

PART 3 EXECUTION

3.1 VALVE SHIPMENT AND STORAGE

- A. Provide flanged openings with metal closures at least 3/16-inch thick, with elastomer gaskets and at least four full-diameter bolts. Install closures at the place of valve manufacture prior to shipping. For studed openings, use all the nuts needed for the intended service to secure closures. Alternatively, ship flanged valves 3 inches and smaller in separate sealed cartons or boxes.
- B. Provide threaded openings with steel caps or solid-shank steel plugs. Do not use nonmetallic (such as plastic) plugs or caps. Install caps or plugs at the place of valve manufacture prior to shipping. Alternatively, ship valves having threaded openings or end connections in separate sealed cartons or boxes.
- C. Store resilient seated valves in sealed polyethylene plastic enclosures with a minimum of one package of desiccant inside. Store resilient seated valves in the open or unseated position. Valves with adjustable packing glands shall have the packing gland loosened prior to storage. Inspect valves at least once per week, replace desiccant if required and repair damaged storage enclosures. Do not store valves with resilient seats near electric motors or other electrical equipment.
- D. Inspect valves on receipt for damage in shipment and conformance with quantity and description on the shipping notice and order. Unload valves carefully to the ground without dropping. Use forklifts or slings under skids. Do not lift valves with slings or chain around operating shaft, actuator, or through waterway. Lift valves with eyebolts or rods through flange holes or chain hooks at ends of valve parts.
- E. Protect the valve and actuators from weather and the accumulation of dirt, rocks, and debris. Do not expose rubber seats to sunlight or ozone for more than 30 days. Also, see the manufacturer's specific storage instructions.
- F. Make sure flange faces, joint sealing surfaces, body seats, and disc seats are clean. Check the bolting attaching the actuator to the valve for loosening in transit and handling. If loose, tighten firmly. Open and close valves having manual or power actuators to make sure the valve operates properly and that stops or limit switches are correctly set so that the valve seats fully. Close valve before installing.

3.2 *FACTORY PRESSURE TESTING*

- A. Hydrostatically test the valve pressure-containing parts at the factory per the valve specification or per the referenced standard. If no testing requirement is otherwise specified or described in the referenced standards, then test with water for 30 minutes minimum at a pressure of 1.5 times the rated pressure but not less than 20 psig. Test shall show zero leakage. If leaks are observed, repair the valve and retest. If dismantling is necessary to correct valve deficiencies, then provide an additional operational test and verify that the valve components function.

3.3 *INSTALLING VALVES - GENERAL*

- A. Remove covers over flanged openings and plugs from threaded openings, after valves have been placed at the point to which the valves will be connected to the adjacent piping. Do not remove valves from storage cartons or boxes until they are ready to be installed.
- B. Handle valves carefully when positioning, avoiding contact or impact with other equipment, vault or building walls, or trench walls.
- C. Clean valve interiors and adjacent piping of foreign material prior to making up valve to pipe joint connection. Prepare pipe ends and install valves in accordance with the pipe manufacturer's instructions for the joint used. Do not deflect pipe-valve joint. Do not use a valve as a jack to pull pipe into alignment. The installation procedure shall not result in bending of the valve/pipe connection with pipe loading.
- D. Make sure valve ends and seats are clean. Check exposed bolting for loosening in transit and handling and tighten to manufacturer's recommendations. Open and close the valve to make sure it operates properly and that stops or limit switches are correctly set so that the vane, ball, gate, needle, diaphragm, disc, plug, or other seating element seats fully. Close the valve before installing. Check coatings for damage and repair. Handle valves carefully when positioning, avoiding contact or impact with other equipment or structures
- E. Prior to assembly, coat threaded portions of stainless steel bolts and nuts with lubricant.

3.4 *INSTALLING EXPOSED VALVES*

- A. Unless otherwise indicated in the drawings, install valves in horizontal runs of pipe having centerline elevations 4 feet 6 inches or less above the floor with their operating stems vertical. Install valves in horizontal runs of pipe having centerline elevations between 4 feet 6 inches and 6 feet 9 inches above the floor with their operating stems horizontal.
- B. Install valves on vertical runs of pipe that are next to walls with their stems horizontal, away from the wall. Valves on vertical runs of pipe that are not located next to walls shall be installed with their stems horizontal, oriented to facilitate valve operation.

3.5 *INSTALLING BURIED VALVES*

- A. Connect the valve, coat the flanges and place and compact the backfill to the height of the valve stem.
- B. Connect the valve, coat the flanges, apply polyethylene encasement, and place and compact the backfill to the height of the valve stem.
- C. Place block pads under the riser pipe to maintain the valve box vertical during backfilling and repaving and to prevent the riser pipe from contacting the valve bonnet.
- D. Secure the riser pipe with backfill and compact. Install the valve box and pour the concrete collar. In pavement areas pour the collar to 2 inches below the finished pavement grade to allow asphalt concrete to be placed over the collar. In non-paved areas, place the collar to the top of the valve box.

3.6 *FIELD COATING BURIED VALVES*

- A. Coat flanges of buried valves and the flanges of the adjacent piping, and the bolts and nuts of flanges and mechanical joints, per Section 09 90 00, System No. 24.
- B. Wrap buried metal valves 6 inches and in two layers of polyethylene conforming to AWWA C105, 8 mils in thickness each. Pass the two sheets of polyethylene under the valve and the coated flanges or joints with the connecting pipe and draw the sheets around the valve body, the valve bonnet, and the connecting pipe. Secure the sheets with plastic adhesive tape about the valve stem below the operating nut and about the barrel of the connecting pipe to prevent the entrance of soil. Fold overlaps twice and tape. Backfill the valve with care to avoid damaging the polyethylene.

3.7 *ASSEMBLING JOINTS*

- A. Bolt holes of flanged valves shall straddle the horizontal and vertical centerlines of the pipe run to which the valves are attached. Clean flanges by wire brushing before installing flanged valves. Clean flange bolts and nuts by wire brushing, lubricate threads with oil and graphite, and tighten nuts uniformly and progressively. If flanges leak under pressure testing, loosen or remove the nuts and bolts, reseal or replace the gasket, reinstall or retighten the bolts and nuts, and retest the joints. Joints shall be watertight.
- B. Clean threaded joints by wire brushing or swabbing. Apply Teflon joint compound or Teflon tape to pipe threads before installing threaded valves. Joints shall be watertight.

3.8 *INSTALLING EXTENSION STEM GUIDE BRACKETS*

- A. Install at 6 to 8-foot centers. Provide at least two support brackets for stems longer than 10 feet, with one support near the bottom of the stem and one near the top.

3.9 MOUNTING GEAR ACTUATORS

- A. The valve manufacturer shall select and mount the gear actuator and accessories on each valve and stroke the valve from fully open to fully closed prior to shipment.

3.10 FIELD INSTALLATION OF GEAR ACTUATOR

- A. Provide the actuator manufacturer's recommended lubricating oil in each actuator before commencing the field testing.

3.11 VALVE FIELD TESTING

- A. Test valves for leakage at the same time that the connecting pipelines are hydrostatically tested. See Section 40 05 00 for pressure testing requirements. Protect or isolate any parts of valves, actuators, or control and instrumentation systems whose pressure rating is less than the pressure test. Valves shall show zero leakage. Repair or replace any leaking valves and retest.
- B. Operate manual valves through three full cycles of opening and closing. Valves shall operate from full open to full close without sticking or binding. Do not backfill buried valves until after verifying that valves operate from full open to full closed. If valves stick or bind, or do not operate from full open to full closed, repair or replace the valve and repeat the tests.
- C. Gear actuators shall operate valves from full open to full close through three cycles without binding or sticking. The pull required to operate handwheel- or chainwheel-operated valves shall not exceed 40 pounds. The torque required to operate valves having 2-inch AWWA nuts shall not exceed 150 ft-lbs. If actuators stick or bind or if pulling forces and torques exceed the values stated previously, repair or replace the actuators and repeat the tests. Operators shall be fully lubricated in accordance with the manufacturer's recommendations prior to operating.

END OF SECTION

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SECTION 40 05 97

IDENTIFICATION FOR PROCESS EQUIPMENT

PART 1 GENERAL

1.1 WORK INCLUDED

- A. This section includes furnishing and installing markers, labels, tags, and signs for piping, valves, and equipment.

1.2 RELATED WORK

- A. Section 09 90 00 – Painting and Coating
- B. Section 40 05 00 – Piping and Fittings
- C. Section 40 05 23 – Valves and Appurtenances

1.3 REFERENCES

- A. American Society of Mechanical Engineers (ASME) A13.1
- B. American Society for Testing and Materials (ASTM)
- C. American Water Works Association (AWWA)

1.4 SUBMITTALS

- A. Submittals shall be in accordance with the General Conditions and Section 01 33 00.
- B. Submit list of wording, symbols, letter size, and color coding for all identification.
- C. Provide manufacturers catalog literature for each product required.
- D. Submit two samples of each product to be used.
- E. Submit manufacturer's installation instructions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Identification shall be by Brady Corporation, Seton, or equal.

2.2 VALVE TAGS

- A. Valve tags shall be brass or stainless steel. Plastic tags will not be accepted.
- B. Tags shall be 40 mils thick and shall include filled text for easy readability.

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- C. Lettering shall be stamped letters with character size and words to ANSI A13.1.
- D. Valve tags shall be attached using stainless steel beaded chain, jack chain or wire. Nylon ties will not be accepted.

2.3 *PIPE MARKERS*

- A. Pipe markers shall include the service name and flow directional arrows. Labeling shall conform to ASME A13.1.
- B. Locate pipe markers at maximum 20 foot centers on straight runs including risers and drops, adjacent to each valve and tee, and at each side of penetration of structure or enclosure.
- C. Labels for indoor locations shall be mechanically fastened or self-adhesive vinyl.
- D. Labels for outdoor locations shall be UV resistant acrylic plastic
- E. Snap-on type markers made of UV resistant acrylic will be accepted for both indoor and outdoor use.
- F. Markers attached with nylon ties will not be accepted.

2.4 *MECHANICAL EQUIPMENT*

- A. Label all mechanical equipment with the equipment description and tag number shown on the drawings.
- B. Labels shall be a minimum of 1-1/2 inches by 4 inches in size and shall be fabricated of aluminum or fiberglass resistant to UV.

2.5 *HAZARDOUS MATERIALS WARNING SIGNS*

- A. Label all chemical storage tanks and entrances to areas containing chemicals with “diamond” warning signs complying with NFPA 704. Size shall be a minimum of 10-inch square
- B. Install 1/8-inch fiberglass wall signs (Brady B-120 or equal). Signs attached to tanks shall be self-adhesive (Brady B-946 or equal).

2.6 *AUTOMATIC EQUIPMENT*

- A. Install automatic start warning signs adjacent to the following equipment. The signs shall include the wording “AUTOMATIC EQUIPMENT – MAY START AT ANY TIME”.

Volute Dewatering Press
Dewatered Solids Conveyor
Polymer Makedown Unit

IDENTIFICATION FOR PROCESS EQUIPMENT
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2.7 TRACER WIRE

- A. Tracer wire to be installed for all plastic pipe 2 inches in diameter and greater.
- B. Minimum: No.10, solid, 12 AWG copper wire with Type TW insulation. Join so as to form a mechanically and electrically continuous line throughout the length of the marked pipe.

PART 3 EXECUTION

3.1 INSTALLATION OF LABELS AND TAGS

- A. Install all tags, signs, and labels in clear view. Pipe markers shall be aligned with axis of pipe.
- B. Degrease and clean surfaces to receive adhesive labels prior to application.
- C. Install valve tags with corrosion resistant ties to the valve handwheel. Valves in main and branch piping shall be tagged.
- D. All valves included in a valve schedule or identified by tag number in the P&ID drawings shall be tagged.
- E. All exposed piping shall be labeled and marked with flow direction arrows.

3.2 TRACER WIRE

- A. Wherever PVC or Polyethylene pipe is installed in the ground, a tracer wire shall be installed. Conductors shall be spliced in accordance with Division 26, Electrical.
 - 1. Tracer wire shall be brought to the surface at all gate and butterfly valves, air valves, blow-offs, Fire Hydrants, Water Services, and other pipeline appurtenances
- B. Tracer Wire: Attachment of the wire to the pipe shall be made with plastic tie-wraps or other approved method.
- C. Contractor shall conduct a satisfactory continuity test prior to Owner acceptance.

END OF SECTION

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SECTION 40 20 90

PVC AND CPVC PROCESS AND CHEMICAL PIPING

PART 1 GENERAL

1.1 WORK INCLUDED

- A. This section includes materials, installation, and testing of PVC and CPVC piping smaller than 4 inches used in process piping and chemical piping.

1.2 RELATED WORK

- A. Section 01 33 00 – Submittal Procedures
- B. Section 40 05 00 – Pipe and Fittings
- C. Section 40 05 23 – Valves and Appurtenances
- D. Section 40 05 07 – Hangers and Supports for Process Piping

1.3 REFERENCES

- A. American Society for Testing and Materials (ASTM)
- B. American Water Works Association (AWWA)

1.4 SUBMITTALS

- A. Submit shop drawings in accordance with Section 01 33 00.
- B. Submit materials description for pipe and fittings with ASTM reference and grade and manufacturer's certification of compliance with referenced standards.
- C. Submit wall thickness and pressure rating of pipe and fittings.

PART 2 PRODUCTS

2.1 PVC PIPE

- A. The material used in the manufacture of the pipe shall be domestically produced rigid polyvinyl chloride (PVC) compound, Type I Grade I, with a Cell Classification of 12454 as defined in ASTM D1784, trade name designation H707 PVC. This compound shall be gray in color as specified, and shall be approved by ANSI/NSF International for use with potable water (NSF Std 61).
- B. PVC pipe shall be manufactured in strict accordance to the requirements of ASTM D1785 for physical dimensions and tolerances. Each production run of pipe manufactured in compliance to this standard, shall also meet or exceed the test requirements for materials, workmanship, burst pressure, flattening, and extrusion quality defined in ASTM D1785. All belled-end pipe shall have tapered sockets to

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create an interference-type fit, which meet or exceed the dimensional requirements and the minimum socket length for pressure-type sockets as defined in ASTM D2672. All PVC Schedule 80 pipe must also meet the requirements of NSF Standard 14 and CSA Standard B137.3 rigid PVC pipe for pressure applications, and shall bear the mark of these Listing agencies. This pipe shall have a flame spread rating of 0-25 when tested for surface burning characteristics in accordance with CAN/ULC-S102-2-M88 or equivalent.

- C. Product marking shall meet the requirements of ASTM D1785 and shall include: the manufacturer's name (or the manufacturer's trademark when privately labeled); the nominal pipe size; the material designation code; the pipe schedule and pressure rating in psi for water @ 73°F; the ASTM designation D1785; the independent laboratory's seal of approval for potable water usage; and the date and time of manufacture.

2.2 CPVC PIPE

- A. The material used in the manufacture of the pipe shall be a rigid chlorinated polyvinyl chloride (CPVC) compound, Type IV Grade I, with a Cell Classification of 23447 as defined in ASTM D1784. This compound shall be light gray in color, and shall be approved by NSF for use with potable water. Material used shall be domestically produced CPVC material as provided by Noveon, Inc. (formerly the BFGoodrich Company), or approved equal.
- B. CPVC Schedule 40 and Schedule 80 pipe shall be manufactured in accordance to the requirements of ASTM F441 for physical dimensions and tolerances. Each production run of pipe manufactured in compliance to this standard, shall also meet the test requirements for materials, workmanship, burst pressure, flattening, and extrusion quality defined in ASTM F441. All belled-end pipe shall have tapered sockets to create an interference-type fit, which meet or exceed the dimensional requirements, and the minimum socket length for pressure-type sockets, as defined in ASTM D2672.
- C. Product marking shall meet the requirements of ASTM F 441 and shall include: the manufacturers name (or the manufacturers trademark when privately labeled); the nominal pipe size; the material designation code; the pipe schedule and pressure rating in psi for water @ 73°F; the ASTM designation F 441; and the independent laboratory's seal of approval for potable water usage. Marking shall also include the flame spread rating and smoke development rating when tested and listed for surface burning characteristics per CAN/ULC S102.2 (Flame Spread (F.S.) of <25 and Smoke Development (S.D.) of <50).

2.3 FITTINGS

- A. PVC fittings shall be schedule 80 grey, socket-type fabricated of ASTM D1784, Type I, Grade 1 conforming to ASTM D2467.
- B. CPVC fittings shall be schedule 80 grey, socket-type fabricated of ASTM D1784, Type IV, Grade 1 conforming to ASTM F439.

2.4 JOINTS

- A. All joints shall be solvent welded or union unless flanged connections are required for adjacent equipment.
- B. All solvent cements used for PVC, except for pipes carrying sodium hypochlorite and sodium hydroxide shall conform to ASTM D-2564 and be listed by ANSI/NSF for potable use applications.
- C. All solvent cements used for CPVC, except for pipes carrying sodium hypochlorite and sodium hydroxide shall conform to ASTM F493 and be listed by ANSI/NSF for potable use applications.
- D. Solvent cement for pipes carrying sodium hypochlorite or sodium hydroxide shall conform to ASTM F493 and be specially formulated for use with corrosive chemicals. Solvent shall be IPS Weld-On 724 or equal.
- E. Unions shall be Schedule 80, shall conform to the materials specifications for fittings, shall be socket joint, and shall utilize EPDM or Viton O-rings compatible with the chemical service.

PART 3 EXECUTION

3.1 DELIVERY AND STORAGE OF PIPE

- A. Do not store pipe where exposed to direct sunlight or heat.
- B. Support the pipe uniformly.
- C. Do not install pipe that is gouged or scratched forming a clear depression.

3.2 SOLVENT CEMENTING

- A. Ensure that the pipe and fittings are at the same temperature prior to joining.
- B. Cut pipe ends square, remove all burrs, and slightly chamfer outside edge of pipe ends.
- C. Remove all dirt and moisture from the surfaces being joined.
- D. Measure the socket depth and mark distance on the pipe being inserted. Check the dry fit of the components prior to applying cement.
- E. Apply primer to both the pipe and fitting following the primer manufacturer's instructions.
- F. Apply solvent cement appropriate for the pipe material and service following the manufacturer's instructions.
- G. Allow the joint to set and cure following the cement manufacturer's instructions. Do not load the joint for at least 8 hours after joint assembly.

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3.3 *INSTALLING UNIONS*

- A. Install unions at the following locations whether shown on the plans or not:
 - 1. Changes in direction
 - 2. Next to all valves and other equipment
 - 3. Every 10 feet on above grade straight pipe runs.
 - 4. Where shown on the drawings.

3.4 *INSTALLING BURIED PIPE*

- A. Follow standard ASTM D2774 installation practice.
- B. Snake the pipe in the trench per the pipe manufacturer's recommendations to account for thermal contraction and expansion.
- C. Support the pipe continuously on a smooth surface void of any stones or sharp objects.

3.5 *PAINTING AND COATING*

- A. Coat pipe exposed to direct sunlight per Section 09 90 00.

3.6 *FIELD HYDROSTATIC TESTING*

- A. Pressure test in accordance with Section 40 05 00.

END OF SECTION

SECTION 43 41 43

POLYETHYLENE CHEMICAL STORAGE TANKS

PART 1 GENERAL

1.1 WORK INCLUDED.

- A. The Contractor shall furnish and install all materials and equipment and provide all labor necessary to complete the work shown on the drawings and/or listed below and all other work and miscellaneous items not specifically mentioned but reasonably inferred for a complete installation, including all accessories and appurtenances required for a completed system.
- B. This section covers the furnishing of linear or cross-linked polyethylene plastic tanks for aboveground bulk storage of chemical solutions as required.
- C. Piping, pipe supports, valves, and accessories which are not an integral part of the equipment or are not specified herein are covered in other sections.

1.2 RELATED WORK

- A. Section 01 33 00 – Submittal Procedures
- B. Section 09 90 00 – Painting and Coating
- C. Section 11 00 00 – General Equipment Requirements
- D. Section 40 05 00 – Pipe and Fittings
- E. Section 40 05 23 – Valves and Appurtenances

1.3 REFERENCES.

- A. Except as modified or supplemented herein, materials and construction methods shall comply with the applicable provisions of the following standard:
 - 1. ASTM International:
 - a. D 638 Standard Test Method for Tensile Properties of Plastics.
 - b. D 790 Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
 - c. D 1505 Standard Test Method for Density of Plastics by the Density-Gradient Technique.
 - d. D 1525 Standard Test Method for Vicat Softening Temperature of Plastics.

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- e. D 1693 Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.
 - f. D 1998 Standard Specification for Polyethylene Upright Storage Tanks.
 - g. F 412 Standard Terminology Relating to Plastic Piping Systems
- 2. NSF/ANSI 61, Drinking Water System Components
 - 3. NFPA 704 Standard System for the Identification of the Hazards of Materials for Emergency Response

1.4 SUBMITTALS

- A. As specified in Section 01 33 00.
- B. Drawings and data for the chemical storage tanks, including the following:
 - 1. Complete drawings, details, and specifications covering the storage tanks and accessories.
 - 2. Full information on basic materials and test data confirming the chemical resistance of the proposed resins to the tank contents.
 - 3. The sizes of all major tank components. Size and arrangement of all piping and instrumentation connections.
 - 4. Anchor bolt locations, size, embedment, and type, including ICBO reports (if applicable).
 - 5. Details concerning field assembly and installation.
 - 6. Proof of NSF/ANSI 61 certification for use with the specified chemical.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS.

- A. Acceptable manufacturers shall be one of the following or equal:
 - 1. Poly Processing
 - 2. Assman Corporation of America.
 - 3. Snyder Industries, Inc.

2.2 DESIGN CONDITIONS AND REQUIREMENTS.

- A. Where two or more units of the same class of equipment are required, they shall be the product of a single manufacturer.
- B. Each tank shall be designed for storage of the chemical or chemicals specified at the design conditions as required. The tanks shall be vertical cylinder with flat bottom and domed top. Each tank shall be vented and will normally be used to store the specified chemical at atmospheric pressure, but shall be designed to withstand the hydrostatic pressure resulting from the tank being surcharged with the stored chemical to 6 inches above the top of the tank. Useable capacity shall be measured from the invert of the overflow nozzle to the top of the pump suction nozzle.
- C. Tanks shall be fabricated with a design hoop stress formula not to exceed 600 psi. Mechanical properties of the tank shall meet the following standards:

Property	ASTM	Cross-linked Value	Linear Value
Density, resin	D 1505	0.938-0.944 g/cc	0.938-0.944 g/cc
Environmental stress cracking resistance, F50	D 1693	>1,000 hours	400-1,000 hours
Tensile strength, ultimate (2 in/min)	D 638	2,600 psi	2,600 psi
Elongation at break (2 in/min)	D 638	400%	350%
Vicat softening point	D 1525	248°F	235°F
Brittleness temperature	D 746	Less than -180°F	Less than -180°F
Flexural Modulus	D 790	100,000 psi	97,000-

2.3 EQUIPMENT BASES.

- A. Unless otherwise indicated or specified, all tanks will be installed on concrete bases at least 6 inches high. The tanks will be anchored to the concrete base with suitable anchor bolts.

2.4 MATERIALS.

- A. Basic tank materials shall be as recommended by the tank manufacturer for the resistance to the stored chemical. In cases where both linear and cross-linked polyethylene resin offer equal chemical resistance, crosslinked polyethylene shall be used. Material of construction for exposed metal, protected metal, assembly and anchor bolts, nuts, and washers shall be as required.

2.5 CONSTRUCTION.

- A. The tanks shall be rotationally molded resin construction in accordance with the applicable governing standard. The wall thickness shall be uniform throughout the entire tank. Heat shielding of parts of the tank mold will not be acceptable.

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- B. Tanks to be installed outdoors shall contain a suitable ultraviolet stabilizer, minimum 0.3 percent 2-hydroxy-4-n-Octoxy-benzophenone or equivalent. The stabilizer shall be compounded into the polyethylene.
- C. Suitable lifting lugs shall be provided on each tank for handling and installation. A lateral tie-down assembly shall be provided for securing the tank to the concrete base.

2.6 ACCESSORIES.

- A. Special Tools and Accessories: Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.
- B. Access Manholes: An access manhole shall be provided on the top of the tank when required. Manholes shall include a polyethylene gasket, 1/2 inch PVC bolts, and a polyethylene cover plate. Manhole inside diameter shall be as required.
- C. Flanged Nozzles: Nozzles for connecting piping and accessories shall be provided on each tank at the locations and of the sizes as indicated in the schedule.
 - 1. Each nozzle shall be flanged, with flange diameter and drilling conforming to ANSI B16.5, Class 150. Nozzles shall extend at least 4 inches from outside face of tank to face of flange.
 - 2. Nozzles shall be fabricated of CPVC for sodium hypochlorite or sodium hydroxide tanks, PVC for all other tanks. All connections hard-piped to the tank shall include flexible hose to allow for expansion and contraction of the tank during filling and draining.
 - 3. Nozzles at or below the tank overflow line shall be connected to the tank with bolted double flange fittings. The bolted double flange fittings shall be constructed of two 150 lb flanges, two 150 lb gaskets, and the correct number and size of all-thread bolts for the flange as specified by the flange manufacturer. The head of the bolt shall be encapsulated in polyethylene to keep it from coming into contact with the stored solution.
 - 4. Bulkhead fittings will be acceptable for all nozzles above the tank overflow line. Gaskets shall be a minimum of 1/4 inch thickness and constructed of material chemically resistant to the proposed tank contents.
 - 5. Each tank drain nozzle shall include a siphon tube that extends to within 1/2 inch of the tank bottom to allow nearly complete draining of the tank.
 - 6. The liquid level transmitter mounting flange shall be not less than 18 inches above the maximum liquid level. The center line of the nozzle shall be at least 24 inches from the tank sidewall, fill nozzle, and other obstructions.
- D. Vents: The tank shall be provided with a vent of the size recommended by the manufacturer to prevent pressurizing the tank during filling or drawing a vacuum

inside the tank during pumping or draining. The vent shall be mushroom or gooseneck type, or shall be connected to a vent piping system, as required.

- E. Sight Level Gauge: When required, each tank shall be provided with a sight level gauge. The gauges shall be clear type or magnetic flag type, as required.
- F. Clear Type Level Gauge: When required, a chemical-resistant valve and gauge tube assembly shall be mounted on the tank. The gauge tube shall be fabricated of 1 inch diameter clear PVC, borosilicate glass, or clear PFA Teflon, as required. Steel protection rods shall be provided the full length of the gauge. Valve assemblies shall be of chemically resistant material with integral ball checks to prevent flow in the event of gauge tube failure. A graduation strip shall be mounted adjacent to the sight level gauge. The strip shall run the full length of the level gauge and shall be graduated in 1-inch high black lettering over a range from zero gallons to the rated capacity of the tank. The gauge tube assembly shall be manufactured by Ernst Gage Company, Jogler Inc. or equal.
- G. Ultrasonic Type Gauges: When required, ultrasonic type level indicators shall be externally mounted and consist of a chemical resistant level element (LE) and a separately mounted level indicating transmitter (LIT). The appropriate flanges, baffles, and/or stilling wells shall be provided as required.
- H. Gallonage Strip: When required, the tank shall be provided with an adhesive gallonage strip. The strip shall run the full length of the tank and shall be graduated in 2 inch high black lettering over a range from 0 gallons to the rated capacity of the tank.
- I. Mixer: When required, the tank shall be provided with a mixer suitable for continuous operation. The mixer shall be driven by a 480 volt, 60 Hz, 3 phase TEFC chemical duty electric motor. Minimum motor horsepower shall be as required. The rotating speed of the mixer shall not exceed 1,750 rpm. The mixer shall be located to provide thorough mixing. Each mixer shall be mounted on a support beam running across the top of the tank. Clamp-mounted mixers will not be accepted. The mixer shaft and impeller shall be fabricated of AISI Type 316 stainless steel. The motor starter and miscellaneous contacts shall be as specified in other sections.
 - 1. A solid-state reset timer having a range of 1 minute to 100 hours shall be supplied with the mixer to stop the mixer at the end of the set time period. The enclosure shall be mounted in the MCC, shall be epoxy coated, and shall include a heavy-duty, oil tight, "ON-OFF (Reset)-AUTOMATIC" selector switch and wiring to a terminal strip.

2.7 ANCHOR BOLTS.

- A. Anchor bolts with associated nuts and washers shall be furnished as required for each item of equipment. Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete is placed.

- B. The bolts shall be at least 3/4 inch in diameter.
- C. Anchor bolts shall be long enough to accommodate at least 1-1/2 inches of grout beneath the base plate and to provide adequate anchorage into structural concrete.
- D. Anti-seize compound will be applied to the threads of all stainless steel bolts before assembly.

2.8 SIGNAGE.

A. Nameplates

- 1. Each tank shall be provided with a nameplate to identify the chemical stored. The nameplates shall be of white phenolic material with black engraved lettering 3 inches high and shall be mounted on the tank side shell. The chemical designation and the tank number to be engraved on the nameplate shall be as required.

B. Certification Plates.

- 1. A stainless steel certification plate shall be mounted below each storage tank's nameplate. The following data shall be included on the certification plate:
 - a. Name of tank fabricator.
 - b. Date of manufacture.
 - c. Maximum allowable concentration and temperature of the specified
 - d. Chemical solution that can be stored safely.
 - e. Tank capacity in gallons. (Useable capacity)

- C. Contractor shall provide NFPA 704 diamond placard visible from door, mounted on the side shell of the tank for the specified chemical.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Tanks shall be set vertically and in true alignment, at the elevations indicated and at the locations shown on the Plans.
- B. Contractor shall be responsible to repair any damage to the tank or components due to transportation or installation.
- C. Tanks and accessories shall be installed and handled according to the manufacturer's recommendations as shown in the installation and use instructions.

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D. All connections to the tank shall be flexible.

3.2 SCHEDULE

Chemical	Neat Polymer
Tag Number	CST-01, CST-02
Number of Tanks	2
Tank Volume	4,925 gal
Tank Diameter	9'-0"
Tank Side Shell Height	10'-5"
Tank Material	Cross Linked PE
Tank Material Specific Gravity	1.35
Tank Style	Vertical

END OF SECTION

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SECTION 46 76 00 RESIDUALS DEWATERING SYSTEM

PART 1 GENERAL

1.1 DESCRIPTION

- A. This section describes materials, fabrication, coating, testing, delivery and installation of a complete Residuals Dewatering System including Volute Dewatering Press, Dewatered Solids Conveyor, Polymer Make Down Unit, Sludge inlet flowmeter, together with associated sludge conditioning tank(s), control panel, and all appurtenances as specified in the Contract Documents.
- B. The Owner procured the Residuals Dewatering System required for this project. Appended to this section is the submittal drawings from PWTech the system Supplier (Supplier). The Contractor is responsible for installation and start-up of the Owner Furnished Equipment.

1.2 SYSTEM COMPONENTS

- A. Volute Dewatering Press
 - 1. The unit to be supplied will be an ES-353[2] with a current capacity of up to 1300 lbs per hour of 3% sludge.
 - 2. The Dewatering Press consists of:
 - a. Flash mixing tank including gear motor and tilted blade impeller mixer
 - b. Flocculation tank including gear motor and large cross-sectional area impeller
 - c. Two (2) x 350 Series Dewatering Drums, each with a drive motor,
 - d. Filtrate collection pan and support frame.
 - e. Integrated, pre-wired control panel for the unit and appurtenances mounted on the flocculation tank.
 - f. The unit is designed with the ability to easily add up to one [1] additional dewatering drum to increase capacity by up to 50% at a future date.
 - 3. Connections:
 - a. Inlet: DN 4" ANSI B16.5 Class 150
 - b. Filtrate outlet: DN 8" ANSI B16.5 Class 150
 - c. Washwater Water inlet: ¾" FNPT

RESIDUALS DEWATERING SYSTEM
46 76 00-1

B. Solids Dewatering Conveyor

1. Design

- a. Loading = 200 cubic feet per hour
- b. 30 foot approximate length
- c. 20-degree incline configuration
- d. One (1) rectangular inlet
- e. One (1) end discharge outlet

2. Construction

- a. U-Trough: 10 and 7ga - 304SS
- b. Trough Lids: 10 and 7ga - 304SS (Bolted / 5ft max with neoprene gasketing)
- c. Trough Liners: min 9/16 in thick UHMWPE, maximum 4ft lengths
- d. Supports: connection points on conveyor – support legs shipped loose to be installed by Contractor.
- e. Drive: 5HP

3. Electrical components:

- a. One (1) Emergency stop switch c/w cable, mounting hardware, 120VAC NEMA 4
- b. One (1) Loss of rotation (LOR) sensor model MSP-12 + MSA-4P alarm/control panel NEMA 4

C. Polymer Makedown Unit

1. VeloBlend model VM-10P-1200-X0D

2. Polymer Mixing Chamber

- a. A high energy, multi-zoned, hydro-mechanical mixing device designed to effectively activate, dilute and mix polymer and dilution water utilizing an impeller designed to produce variable intensity, back-flow mixing action to optimize polymer performance without damage to the polymer's molecular structure.
- b. Mixer Motor: ½ HP, 90 VDC, 1750 RPM, Wash-Down Duty with keyless shaft and left hand impeller mounting screw

- c. Mechanical Mixer Shaft Seal and Seal Flushing Assembly with ON/OFF Valve
 - d. Velo-Check neat polymer poppet style check valve specifically designed to isolate neat polymer and dilution water. The check valve shall be held in place by a quick release pin for easy assembly and disassembly.
 - e. Materials of construction are PVC and Lexan (Body), Viton, SS304 and ceramic (Seals) and SS304
 - f. Pressure Rating: 100 psi
3. Neat Polymer Metering Pump
- a. A stainless steel & Viton 10GPH progressive cavity metering pump shall be provided
 - b. ½ HP, 2500 RPM, 90 VDC, TEFC Motor with 10:1 Gear Reducer
 - c. Thermal type loss of polymer flow sensor
 - d. Metering pump calibration assembly with isolation valves: (1000 ml)
4. Dilution Water Inlet and Solution Outlet Assembly
- a. Primary 120-1200 GPH controllable dilution water flow
 - b. 1" FNPT water inlet connection with Dilution Water ON/OFF Solenoid Valve
 - c. Low differential pressure alarm switch
 - d. 0-160 psi inlet water pressure gauge (stainless steel, liquid filled)
5. Construction
- a. Frame and fasteners are 304 stainless steel. Frame is open design for access to all components and is designed for bolt-down installation.

D. Influent Flowmeter

- 1. Size: 3-inch Diameter with ANSI 150 lb flange connections.
- 2. Coated Carbon Steel construction with a polyurethane, ceramic, neoprene, or Teflon liner.
- 3. All metallic wetted parts are stainless steel type 316.
- 4. Suitable for direct burial and constant flooding (IP 68).
- 5. Includes grounding rings

RESIDUALS DEWATERING SYSTEM
46 76 00-3

6. Flowmeter out-puts analogue signal (4-20 mA) to Volute Dewatering Press Control Panel

1.3 WORK TO BE INCLUDED BY CONTRACTOR

- A. The following work will be completed by the Contractor unless otherwise agreed between the Supplier and the Contractor:
 1. Concrete foundation.
 2. System offloading from delivery truck.
 3. System installation and connection to all inlet and outlet piping and fittings.
 4. Supply and installation of anchor bolts for foundation.
 5. Connection to electrical and communications systems.

1.4 RELATED WORK

- A. Section 09 90 00 – Painting and Coating
- B. Section 40 05 00 – Pipe and Fittings

PART 2 MATERIALS

NOT USED. SEE APPENDED SUBMITTAL DOCUMENTS.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Installation of the equipment in the Residual Dewatering System and related appurtenances shall be performed by the Contractor unless otherwise agreed between the Supplier and the Contractor, and will be in accordance with the Supplier's drawings, instructions, and recommendations.

3.2 START-UP SERVICES AND TESTING

- A. The Supplier shall include one (1) trip for on-site start-up and training services.
 1. Trip shall include four (4) consecutive days (8 hours per day, Monday-Friday) by a PWT field service engineer and/or manufacturer's representative
- B. While onsite Manufacturer's Representative shall perform:
 1. Installation inspection
 2. Commissioning of Volute Dewatering Press unit and Controls
 3. Start-up of Ancillary equipment including

RESIDUALS DEWATERING SYSTEM
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City of Tulare
Industrial WWTP Dewatering Project

- a. Dewatered Solids Conveyor
 - b. Polymer Makedown Unit
 - c. Influent Flowmeter
- 4. Functional testing and calibration of equipment
- 5. Training on all equipment
- C. Phone consultation regarding installation will also be provided.
- D. Should additional services be deemed necessary by the Contractor, additional services can be procured from PWT on a per diem basis at a cost \$1000 per day plus travel. Additional services shall be at no cost to the Owner.

END OF SECTION

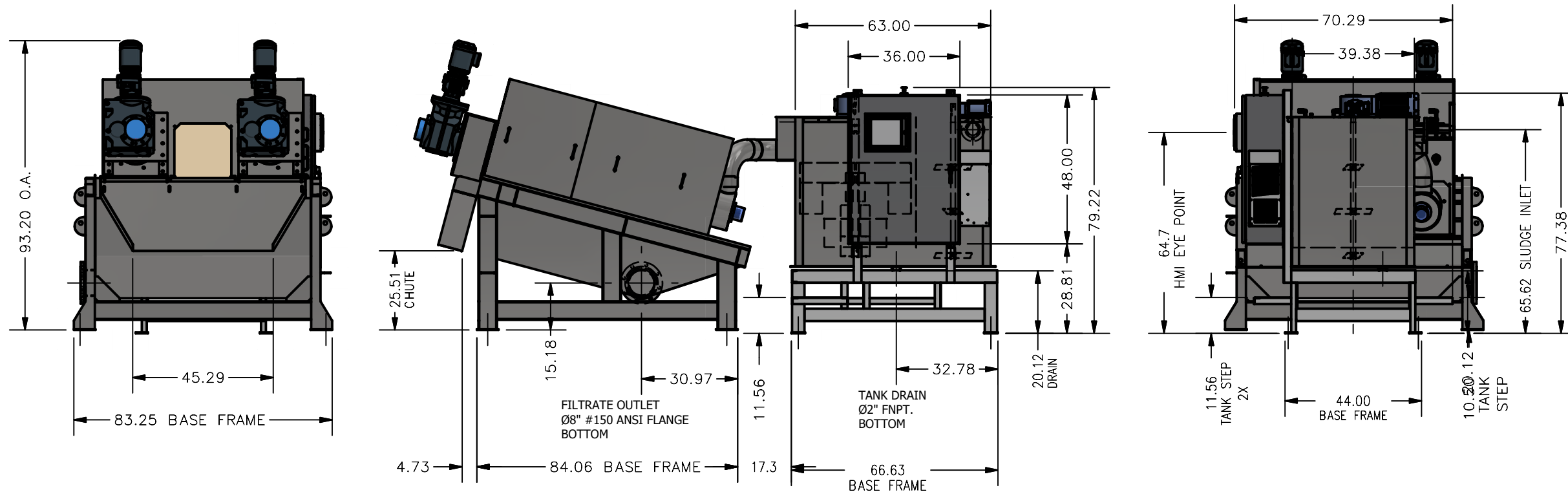
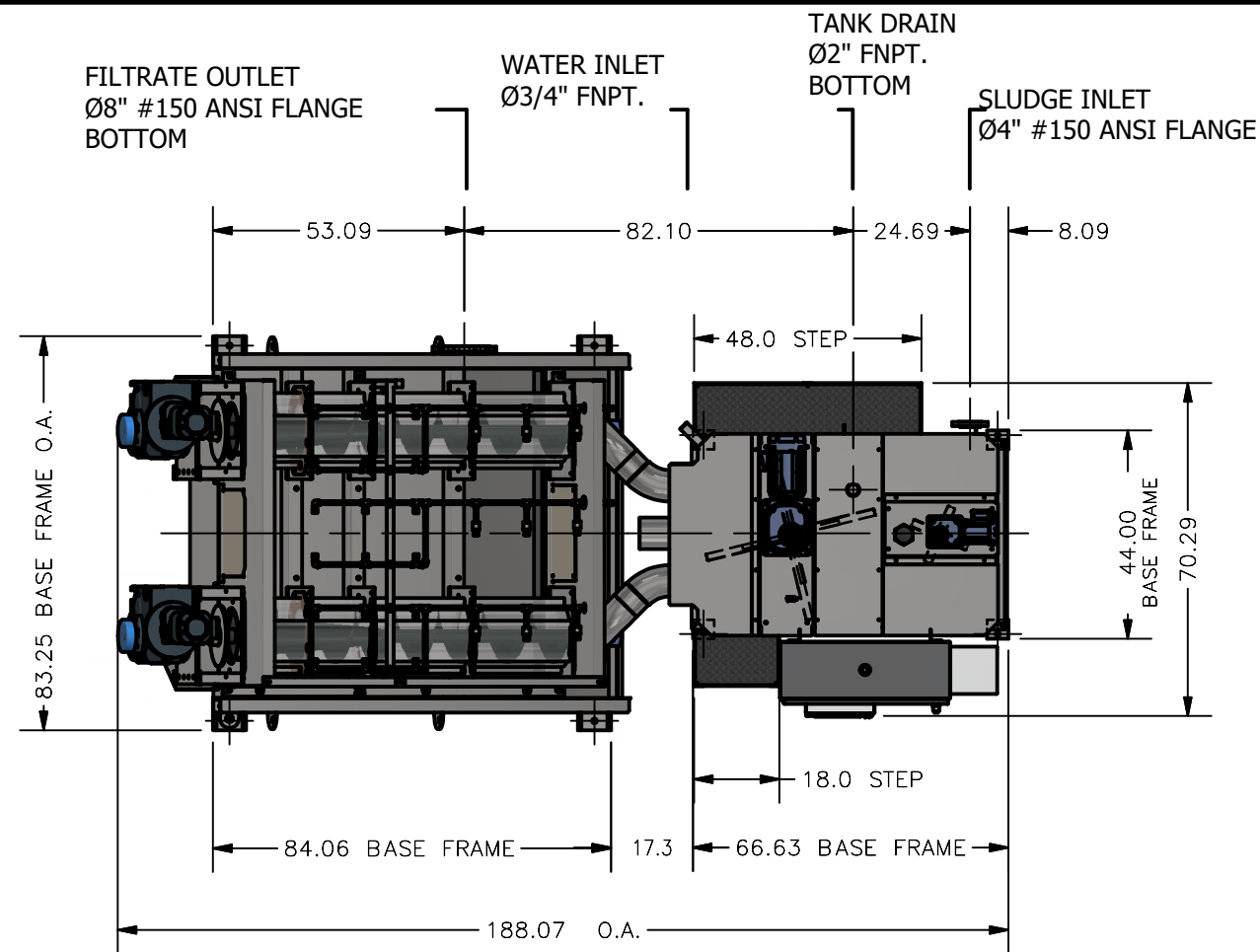
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APPENDIX A

RESIDUALS DEWATERING EQUIPMENT

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DIMENSIONS: INCHES

REVISION AND ISSUE HISTORY

REV	DATE	DESCRIPTION	DR'N	CHK'D
A	06/15/20	FOR SUBMITTAL	JS	HH

DRAWING APPROVAL

APPROVED: B. LOVE DATE: 06/16/20 SIGNATURE:

FOR SUBMITTAL

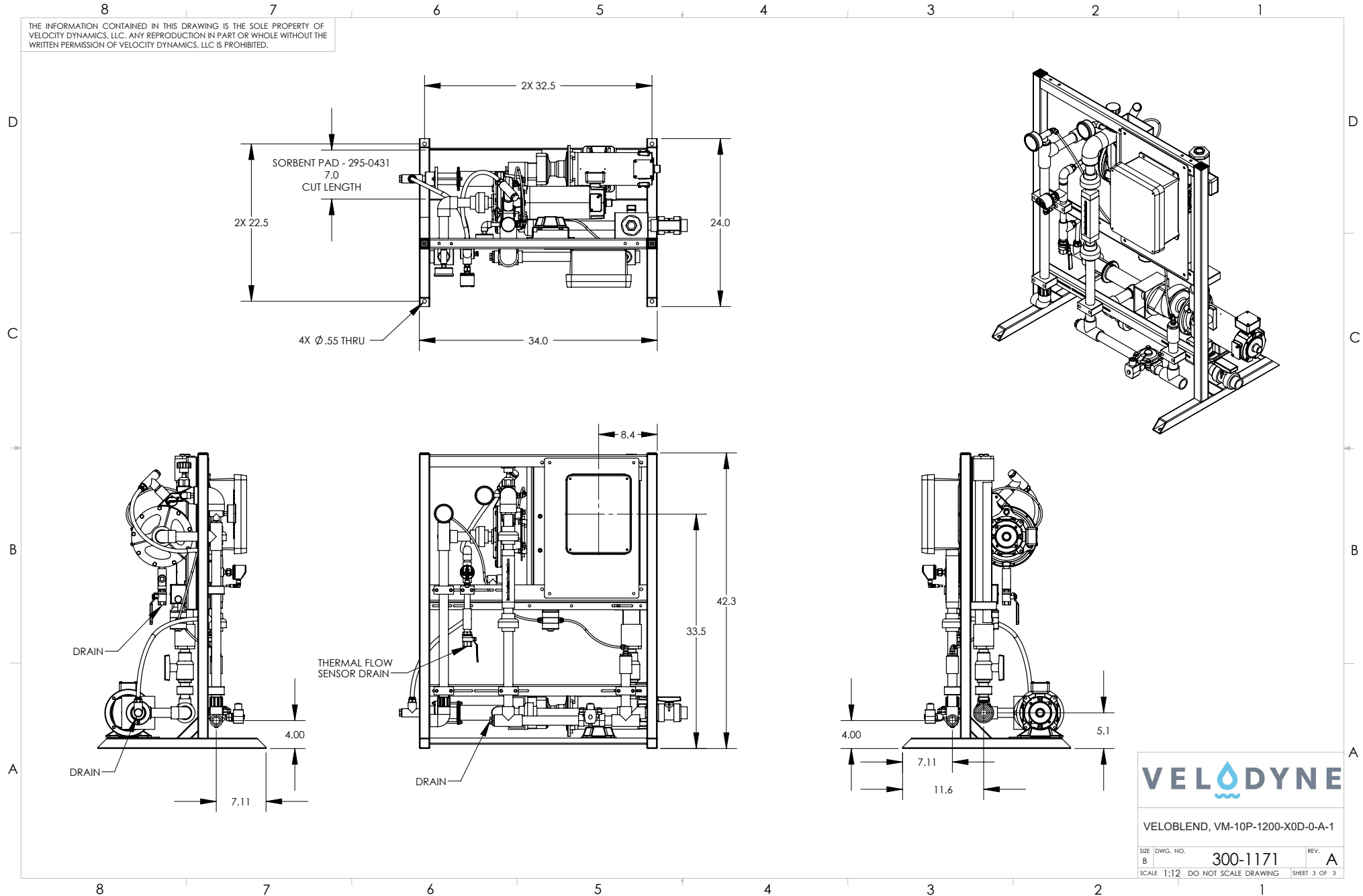
 Process Wastewater Technologies, LLC
9004 Yellow Brick Road, Suite D
Rosedale, Maryland 21237
Tel. 410.238.7977
Fax 410.238.7559
www.PWTech.us

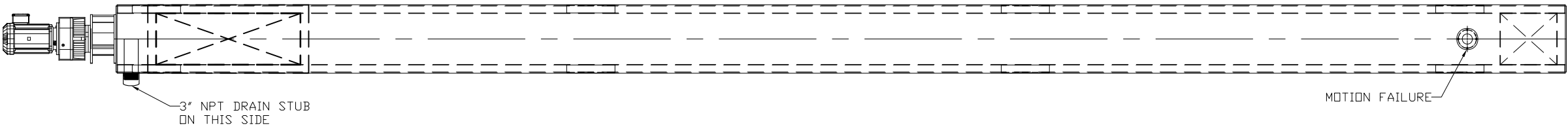
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VOLUTE ES-353[2]
DEWATERING PRESS

PROJECT TITLE
TULARE IWWTP
TULARE, CA.

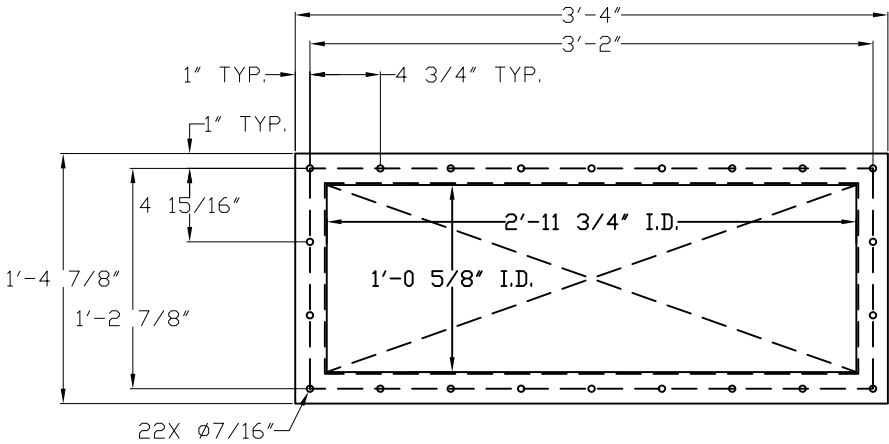
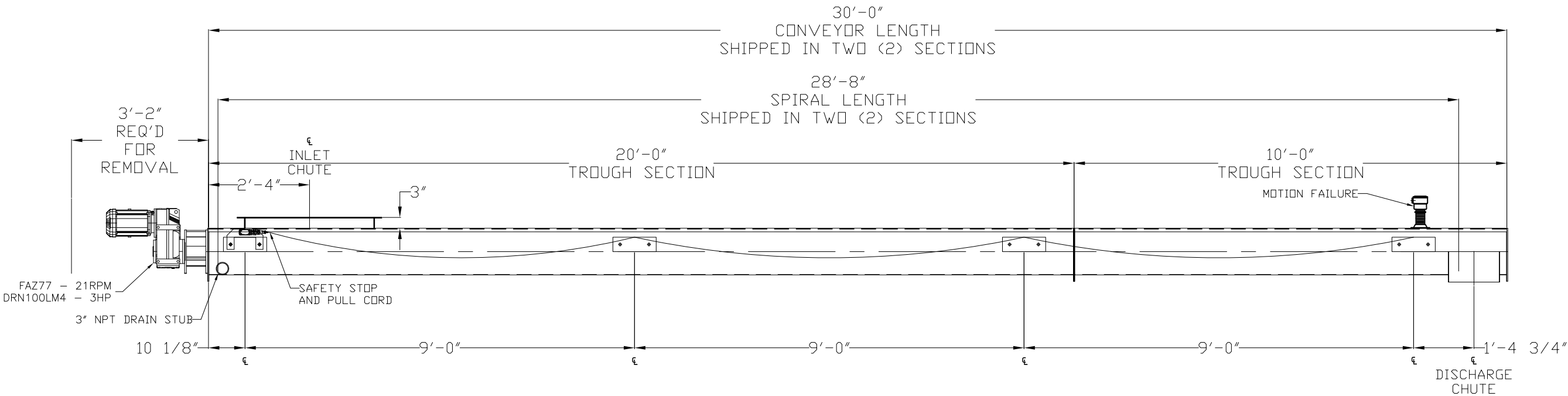
PWT PROJECT NO: VDPNY19166	SCALE 0.025 : 1	SHEET SIZE: 11 X 17
DRAWING NO: 20200612 VDPCA18144 ES353[2] SUB	SHEET: 1 OF 2	REV: A

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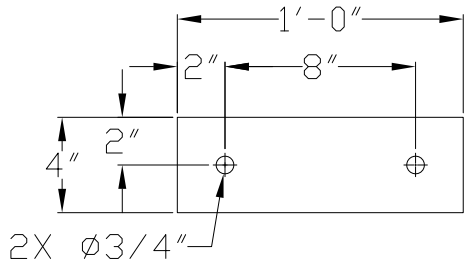




REVISION HISTORY		
REV.	DESCRIPTION	DATE
0	ORIGINAL SUBMISSION	6/1/20



INLET CHUTE FLANGE DETAILS



SUPPORT MOUNT DETAILS



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TITLE:
SHAFTLESS SCREW CONVEYOR
PLAN VIEW

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PROJ. NO. :	202676	MODEL:	U320
SIZE	DWG. NO.	REV	
B	202676-10	0	

APPENDIX B

GEOTECHNICAL ENGINEERING INVESTIGATION REPORT

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**GEOTECHNICAL ENGINEERING INVESTIGATION REPORT
TULARE INDUSTRIAL WWTP DEWATERING
TULARE, CALIFORNIA**

BSK PROJECT G19-314-11F

PREPARED FOR:

**PROVOST & PRITCHARD
286 W. CROMWELL AVENUE
FRESNO, CALIFORNIA 93711**

JANUARY 14, 2020

**GEOTECHNICAL ENGINEERING INVESTIGATION REPORT
TULARE INDUSTRIAL WWTP DEWATERING
TULARE, CALIFORNIA**

Prepared for:

Provost & Pritchard Consulting Group
286 W. Cromwell Avenue
Fresno, California 93711

BSK Project: G19-314-11F

January 14, 2020

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Table 1: Seismic Design Parameters

Table 2: Recommended Static Lateral Earth Pressures for Footings

Figures

Figure 1: Site Vicinity Map

Figure 2: Boring Location Maps

Appendices

Appendix A: Field Exploration

Appendix B: Laboratory Testing



1 INTRODUCTION

1.1 General

This report presents the results of a geotechnical engineering investigation conducted by BSK Associates (BSK), for the Tulare Industrial WWTP Dewatering within the city of Tulare, California. The geotechnical engineering investigation was conducted in accordance with BSK Proposal GF19-19389, dated December 13, 2019.

This report provides a description of the geotechnical conditions at the site and provides specific recommendations for earthwork and foundation design with respect to the planned structures.

1.2 Planned Description

BSK understands that this project consists of the design and construction of new dewatering equipment within the Tulare Industrial WWTP. The proposed improvements are anticipated to be located between the anaerobic digesters and the sludge drying beds.

In the event that significant changes occur in the design of the proposed improvements, this report's conclusions and recommendations will not be considered valid unless the changes are reviewed with BSK and the conclusions and recommendations are modified or verified in writing. Examples of such changes would include location, size of structures, foundation loads, etc.

1.3 Purpose and Scope of Services

The objective of this geotechnical investigation was to characterize the subsurface conditions in the areas of the proposed structures and provide geotechnical engineering recommendations for the preparation of plans and specifications. The scope of the investigation included a field exploration, laboratory testing, engineering analyses, and preparation of this report.

2 FIELD INVESTIGATION AND LABORATORY TESTING

2.1 Field Exploration

The field exploration was performed on December 30, 2019 under the oversight of a BSK Engineer. Two (2) test borings were hand augured to depths of 12 feet below ground surface (bgs) using hand drilling equipment.

The approximate boring locations are illustrated on Figure 2, Boring Location Map. Details of the field exploration and the boring logs are provided in Appendix A.

The soil materials encountered in the borings were visually classified in the field, and the logs were recorded during the excavating and sampling operations. Visual classification of the materials encountered in the borings was made in general accordance with the Unified Soil Classification System (ASTM D 2488). A soil classification chart is presented in Appendix A.



Boring logs should be consulted for more details concerning subsurface conditions. Stratification lines were approximated by the field staff based on observations made at the time of excavating, while the actual boundaries between soil types may be gradual and soil conditions may vary at other locations.

2.2 Laboratory Testing

Laboratory tests were performed on selected soil samples to evaluate moisture content, dry density, shear strength, consolidation, expansion potential, grading analysis, and corrosion characteristics. A description of the laboratory test methods and results are presented in Appendix B.

3 SITE CONDITIONS

3.1 Site Description

The Tulare Industrial WWTP is located at 1875 S. West Street in Tulare, California. The proposed improvements are planned to be in the southeast section of the existing facility. At the time of the subsurface investigation, the proposed site was occupied by various collection basins to the east, above ground tanks to the west, an equipment pad to the north, and light posts running north and south through the work area. The surface of the site contained scattered fine to medium grained sub-rounded cobble. The cobble appeared to be imported fill.

3.2 Subsurface Conditions

The subsurface materials at the site contained approximately 1-foot of silty sand with gravel underlain with layers of silty sand and sandy clay. The fine to medium sub-angular gravel appeared to be an engineered fill. The boring logs in Appendix A provide a more detailed description of the materials encountered, including the applicable Unified Soil Classification System symbols.

3.3 Groundwater

Groundwater was not encountered in our soil borings on December 30, 2019. Based on the groundwater elevation data from the California Department of Water Resources (DWR), the regional groundwater depth at the site is greater than 150 feet bgs.

Please note that the groundwater level may fluctuate both seasonally and from year to year due to variations in rainfall, temperature, pumping from wells and possibly as the result of other factors such as irrigation, that were not evident at the time of our investigation. Groundwater is not anticipated to affect construction.

3.4 Seismic Design Criteria

There are no known active fault zones within the vicinity of the project site. In accordance with Section 1613.2.2 of the 2019 California Building Code (CBC) and Table 20.3-1 of ASCE 7-16, the site can be classified as Site Class D (stiff soil profile).



Use of the mapped 2019 California Building Code (CBC) seismic design criteria is considered appropriate and the following parameters are considered applicable for the structural design of foundations.

Table 1: Seismic Design Parameters			
Seismic Design Parameter	2019 CBC Value		Reference
MCE Mapped Spectral Acceleration (g)	$S_s = 0.626$	$S_1 = 0.239$	USGS Mapped Value
Amplification Factors (Site Class D) ¹	$F_a = 1.299$	$F_v = 2.122$	Table 1613.2.3
Site Adjusted MCE Spectral Acceleration ¹ (g)	$S_{MS} = 0.813$	$S_{M1} = 0.507$	Equations 11.4-1, 2, ASCE
Design Spectral Acceleration ¹ (g)	$S_{DS} = 0.542$	$S_{D1} = 0.338$	Equations 11.4-3, 4, ASCE
Geometric Mean PGA (g)	$PGA_M = 0.363$		ASCE Equations 11.8-1
Long-period transition period (seconds)	12		ASCE Figures 22-14 through 22-17

Notes:

1. F_v shall only be used for calculation of T_s .
2. See requirements for site-specific ground motions in Section 11.4.8 of ASCE 7. Values provided based on use of exception, as provided in Section 11.4.8.2 to Site-Specific Ground Motion Procedures and assumes the value of the seismic response coefficient C_s is determined by Eq. 12.8-2 for values of $T \leq 1.5T_s$ and taken as equal to 1.5 times the value computed in accordance with either Eq. 12.8-3 for $T_L \geq T > 1.5T_s$ or Eq. 12.8-4 for $T > T_L$.

As shown above, the short period design spectral response acceleration coefficient, S_{DS} , is greater than 0.5, therefore the Site lies in Seismic Design Category D as specified in Section 1613.2.5 of the 2019 CBC. The long period design spectral response acceleration coefficient, S_{D1} , is greater than 0.2, therefore the Site lies in Seismic Design Category D as specified in Section 1613.2.5 of the 2019 CBC. In accordance with the 2019 CBC, each structure shall be assigned to the more severe seismic design category in accordance with Table 1613.2.5(1) or 1613.2.5(2), irrespective of the fundamental period of vibration of the structure.

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 General

Based upon the data collected during this investigation and from a geotechnical engineering standpoint, it is our opinion that the soil conditions would not preclude the construction of the proposed improvements. The proposed improvements may be supported on shallow foundations or mat foundations, if the recommendations presented herein are incorporated into the design and construction of the project.

4.1 Soil Corrosivity

Soil samples were tested to evaluate the potential for concrete deterioration or steel corrosion due to attack by soluble salts in the soils at the proposed dewatering site. Results are presented in Appendix B. Based on the test results, the near-surface soil at the site has a negligible soluble sulfate, low chloride



contents, and a low minimum resistivity, and are alkaline. Thus, on-site soils are considered to have a low corrosion potential with respect to buried concrete and a highly corrosive potential to unprotected metal. We recommend that Type II and V cement be used in the formulation of concrete for the site, respectively, with a maximum water/cement ratio of 0.45. We also recommend buried reinforcing steel protection be provided with a minimum concrete cover required by the American Concrete Institute (ACI) Building Code for Structural Concrete, ACI 318-14, Chapter 20.6.1. Buried metal conduits must have protective coatings in accordance with the manufacturer's specifications. If detailed recommendations for corrosion protection are desired, a corrosion specialist should be consulted.

4.2 Site Preparation Recommendations

The following procedures must be implemented during Site preparation for the proposed improvements. References to maximum dry density, optimum moisture content, and relative compaction are based on ASTM D1557 (latest test revision) laboratory test procedures.

1. Prior to any site grading, all miscellaneous surface obstructions must be removed from the improvement area. Within the area of the planned improvements, underground utilities, and debris to expose a clean soil surface free of deleterious material, such as organic matter. Surface stripping must not be incorporated into engineered fill unless the organic content is less than 3 percent by weight (ASTM D2974).
2. Existing utilities must be removed to a point at least 5-feet horizontally outside the proposed improvement area. Resultant cavities must be backfilled with engineered fill. Abandoned pipelines to remain that are less than 2 inches in diameter must be capped at the cutoff point, while pipelines greater than 2 inches in diameter must be filled with a 1-sack sand cement slurry.
3. The proposed dewatering area should be over-excavated to a minimum of one foot below the bottom of the proposed foundations. The over-excavation should extend a minimum of 5 feet from edge of the foundation. The bottom of the over-excavation should be scarified 8 inches, brought to 2 to 3 percent above optimum moisture content and compacted to 90 percent of ASTM D1557. Non-expansive engineering fill should be brought to optimum moisture content and compacted to 90 percent of ASTM D1557.
4. Following the required stripping and over-excavation, the exposed ground surface must be inspected by the Geotechnical Engineer to evaluate if loose or soft zones are present that will require additional over excavation.
5. Imported soil or native, non-expansive ($El < 20$), excavated soils, free of organic materials or deleterious substances, may be placed as compacted engineered fill. The material must be free of oversized fragments greater than 3-inches in greatest dimension. Engineered fill must be placed in uniform layers not exceeding 8-inches in loose thickness, moisture conditioned to at or above optimum moisture content, and compacted to at least 90 percent relative compaction.



6. BSK must be called to the site to verify the import material properties through laboratory testing.
7. Import fill materials must be free from organic materials or deleterious substances. The project specifications must require the contractor to contact BSK to review the proposed import fill materials for conformance with these recommendations at least one week prior to importing to the Site, whether from on-site or off-site borrow areas. Imported fill soils must be non-hazardous and derived from a single, consistent source conforming to the following criteria:

Expansion Index:	< 20 (Very Low Expansion Potential)
Maximum Particle Size:	3 inches
Percent Passing #4 Sieve:	65 - 100
Percent Passing #200 Sieve:	20 - 45
Low Corrosion Potential:	Soluble Sulfates < 1,500 ppm Soluble Chlorides < 150 ppm Minimum Resistivity > 2,000 ohm-cm

If possible, earthwork operations should be scheduled during a dry, warm period of the year. Should these operations be performed during or shortly following periods of inclement weather, unstable soil conditions may result in the soils exhibiting a “pumping” condition. This condition is caused by excess moisture in combination with moving construction equipment, resulting in saturation and zero air voids in the soils. If this condition occurs, the adverse soils will need to be over-excavated to the depth at which stable soils are encountered, and replaced with suitable soils compacted as engineered fill. Alternatively, the Contractor may proceed with grading operations after utilizing a method to stabilize the soil subgrade, which should be subject to review and approval by BSK prior to implementation.

4.3 Foundations

Provided the recommendations contained in this report are implemented during design and construction, it is our opinion that the structures may be supported on a reinforced concrete shallow mat foundation bearing on engineered fill. A structural engineer should evaluate reinforcement, embedment depth based on the requirements for the structural loadings, shrinkage and temperature stresses.

We understand that the new dewatering equipment will be supported on concrete mat foundations. The mat foundations may be designed to impose a maximum allowable bearing pressure of 2,000 pounds per square foot (psf) due to dead plus live loads. This value may be increased by one-third for transient loads such as seismic or wind.

Based on our analysis, the proposed mat foundations will have approximately up to 1.0 inch of total and approximately 1/2 inch of differential settlement for a design load of 2,000 psf. If settlement analysis for other conditions is desired, we can provide settlement based on geometry and loading.



4.4 Lateral Earth Pressures and Frictional Resistance

Provided the site is prepared as recommended above, the following earth pressure parameters for footings may be used for design purposes. The parameters shown in the table below are for drained conditions of select engineered fill or properly compacted and moisture conditioned native soil.

Table 2: Recommended Static Lateral Earth Pressures for Footings	
Lateral Pressure Condition	Equivalent Fluid Density (pcf) Drained Condition
Active Pressure	35
At Rest Pressure	50
Passive Pressure	350

The lateral earth pressures listed herein are obtained by the conventional equation for active, at rest, and passive conditions assuming level backfill and a bulk unit weight of 120 pcf for the site soils. A coefficient of friction of 0.32 may be used between soil sub-grade and the bottom of footings. The coefficient of friction and passive earth pressure values given above represent ultimate soil strength values.

BSK recommends that a safety factor consistent with the design conditions be included in their usage in accordance with Sections 1806.2.1 through 1806.2.3 of the 2019 CBC. For stability against lateral sliding that is resisted solely by the passive earth pressure against footings or friction along the bottom of footings, a minimum safety factor of 1.5 is recommended. For stability against lateral sliding that is resisted by combined passive pressure and frictional resistance, a minimum safety factor of 2.0 is recommended. For lateral stability against seismic loading conditions, a minimum safety factor of 1.2 is recommended.

4.5 Excavation Stability

Soils encountered within the depth explored are generally classified as Type D soils in accordance with OSHA (Occupational Safety and Health Administration). The slopes surrounding or along temporary excavations may be 1:5H:1V for excavations that are less than five feet deep and exhibit no indication of potential caving, but should be no steeper than 2H:1V for excavations that are deeper than five feet, up to a maximum depth of 15 feet. If zones of sand are encountered, the slopes should be laid back to 2H:1V or flatter. Certified trench shields or boxes may also be used to protect workers during construction in excavations that have vertical sidewalls and are greater than 5 feet deep. Temporary excavations for the project construction should be left open for as short a time as possible and should be protected from water runoff. In addition, equipment and/or soil stockpiles must be maintained at least 10 feet away from the top of the excavations. Because of variability in soils, BSK must be afforded the opportunity to observe and document sloping and shoring conditions at the time of construction. Slope height, slope inclination, and excavation depths (including utility trench excavations) must in no case exceed those specified in



local, state, or federal safety regulations, (e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations).

4.6 Trench Backfill and Compaction

Processed, non-expansive, on-site soils, which are free of organic material, are suitable for use as general trench backfill above the pipe envelope. Non-expansive native soil with particles less than three inches in the greatest dimension may be incorporated into the backfill and compacted as specified above, provided they are properly mixed into a matrix of friable soils. The backfill must be placed in thin layers not exceeding 12 inches in loose thickness, be well-blended and consistent texture, moisture conditioned to at least optimum moisture content, and compacted to at least 90 percent of the maximum dry density as determined by the ASTM D1557.

We recommend that trench backfill be tested for compliance with the recommended Relative Compaction and moisture conditions. Field density testing should conform to ASTM Test Methods D1556 or D6938. We recommend that field density tests be performed in the utility trench bedding, envelope and backfill for every vertical lift, at an approximate longitudinal spacing of not greater than 150 feet. Backfill that does not conform to the criteria specified in this section should be removed or reworked, as applicable over the trench length represented by the failing test so as to conform to BSK recommendations.

4.7 Drainage Considerations

The control surface drainage in the project areas is an important design consideration. BSK recommends that final grading around shallow foundations must provide for positive and enduring drainage away from the structures, and ponding of water must not be allowed around, or near the shallow foundations.

5. PLANS AND SPECIFICATIONS REVIEW

BSK recommends that it be retained to review the draft plans and specifications for the project, with regard to foundations and earthwork, prior to their being finalized and issued for construction bidding.

6. CONSTRUCTION TESTING AND OBSERVATIONS

Geotechnical testing and observation during construction is a vital extension of this geotechnical investigation. BSK recommends that it be retained for those services. Field review during site preparation and grading allows for evaluation of the exposed soil conditions and confirmation or revision of the assumptions and extrapolations made in formulating the design parameters and recommendations. BSK's observations must be supplemented with periodic compaction tests to establish substantial conformance with these recommendations. BSK must also be called to the site to observe foundation excavations, prior to placement of reinforcing steel or concrete, in order to assess whether the actual bearing conditions are compatible with the conditions anticipated during the preparation of this report. BSK must also be called to the site to observe placement of foundation and slab concrete.



If a firm other than BSK is retained for these services during construction, then that firm must notify the owner, project designers, governmental building officials, and BSK that the firm has assumed the responsibility for all phases (i.e., both design and construction) of the project within the purview of the geotechnical engineer. Notification must indicate that the firm has reviewed this report and any subsequent addenda, and that it either agrees with BSK's conclusions and recommendations, or that it will provide independent recommendations.

7. LIMITATIONS

The analyses and recommendations submitted in this report are based upon the data obtained from the borings performed at the locations shown on the Boring Location Map, Figure 2. The report does not reflect variations which may occur between or beyond the borings. The nature and extent of such variations may not become evident until construction is initiated. If variations then appear, a re-evaluation of the recommendations of this report will be necessary after performing on-site observations during the excavation period and noting the characteristics of the variations.

The validity of the recommendations contained in this report is also dependent upon an adequate testing and observation program during the construction phase. BSK assumes no responsibility for construction compliance with the design concepts or recommendations unless it has been retained to perform the testing and observation services during construction as described above.

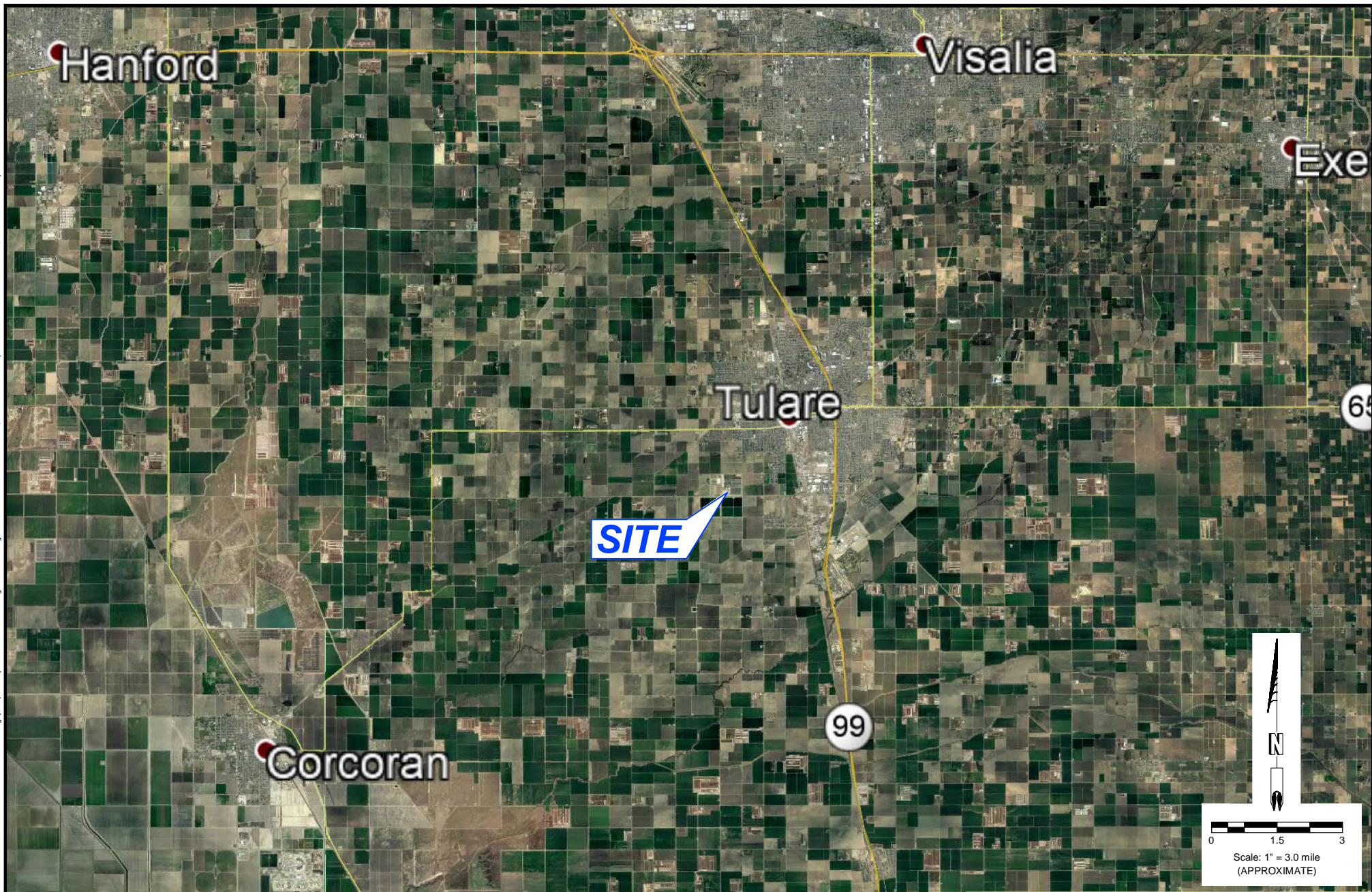
The findings of this report are valid as of the present. However, changes in the conditions of the Site can occur with the passage of time, whether caused by natural processes or the work of man, on this property or adjacent property. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation, governmental policy or the broadening of knowledge.

BSK has prepared this report for the exclusive use of the Client and members of the project design team. The report has been prepared in accordance with generally accepted geotechnical engineering practices which existed in Tulare County at the time the report was written. No other warranties either expressed or implied are made as to the professional advice provided under the terms of BSK's agreement with Client and included in this report.



FIGURES

P:\FRS\Active\GEO\G1931411F - Tulare Industrial WWTP Dewatering\Graphics\G19-314-11F.dwg User:tpgnzolez Plotted:Jan 06, 2020 - 2:00pm Last Saved:Jan 06, 2020 - 1:45pm



REFERENCE IMAGE: Google Earth

ESK
ASSOCIATES
550 West Locust Avenue
Fresno, California 93650
Tel. (559) 497-2880

SITE VICINITY MAP

Tulare Industrial WWTP Dewatering
1875 S West Street
Tulare, California

FIGURE 1

JOB NO.	G19-314-11F	
DATE	January 6, 2020	
DR. BY	TG	SHEET NO. <u>1</u> OF <u>1</u> SHEETS
CH. BY	NP	
SCALE AS SHOWN		

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LEGEND:



APPROXIMATE BORING LOCATIONS

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Fresno, California 93650
Tel. (559) 497-2880

REFERENCE IMAGE: Google Earth

BORING LOCATION MAP

Tulare Industrial WWTP Dewatering
1875 S West Street
Tulare, California

FIGURE 2

JOB NO.	G19-314-11F	
DATE	January 6, 2020	
DR. BY	TG	SHEET NO. <u>1</u> OF <u>1</u> SHEETS
CH. BY	NP	
SCALE AS SHOWN		

APPENDIX A

FIELD EXPLORATION


















APPENDIX A








FIELD EXPLORATION



The field exploration was conducted on December 30, 2019, under the oversight of a BSK Staff Engineer. Two (2) test borings were hand augured to depths of 12 feet below existing ground surface (bgs) using manually advanced augering equipment. The approximate locations of the test borings are indicated on Figure 2, Boring Location Map.

The soil materials encountered in the test borings were visually classified in the field, and logs were recorded by the staff engineer during the drilling and sampling operations. Visual classification of the materials encountered in the test borings were made in general accordance with the Unified Soil Classification System (ASTM D2487). A soil classification chart is presented herein. Boring logs are presented herein and should be consulted for more details concerning subsurface conditions. Stratification lines were approximated by the field staff on the basis of observations made at the time of drilling while the actual boundaries between different soil types may be gradual and soil conditions may vary at other locations.



MAJOR DIVISIONS					TYPICAL NAMES
COARSE GRAINED SOILS More than Half > #200 sieve	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW		WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES
			GP		POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES
		GRAVELS WITH OVER 15% FINES	GM		SILTY GRAVELS, POORLY GRADED GRAVEL-SAND-SILT MIXTURES
			GC		CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS WITH LITTLE OR NO FINES	SW		WELL GRADED SANDS, GRAVELLY SANDS
			SP		POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 15% FINES	SM		SILTY SANDS, POOORLY GRADED SAND-SILT MIXTURES
			SC		CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES
FINE GRAINED SOILS More than Half < #200 sieve	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML		INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL		INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL		ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		MH		INORGANIC SILTS, MICACEOUS OR DIATOMACIOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH		ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
	HIGHLY ORGANIC SOILS		Pt		PEAT AND OTHER HIGHLY ORGANIC SOILS

-  Modified California
-  Standard Penetration Test (SPT)
-  Split Spoon
-  Pushed Shelby Tube
-  Auger Cuttings
-  Grab Sample
-  Sample Attempt with No Recovery
- CA Chemical Analysis
- CN Consolidation
- CP Compaction
- DS Direct Shear
- PM Permeability
- PP Pocket Penetrometer

- RV R-Value
- SA Sieve Analysis
- SW Swell Test
- TC Cyclic Triaxial
- TX Unconsolidated Undrained Triaxial
- TV Torvane Shear
- UC Unconfined Compression
- (1.2) (Shear Strength, ksf)
- WA Wash Analysis
- (20) (with % Passing No. 200 Sieve)
-  Water Level at Time of Drilling
-  Water Level after Drilling (with date measured)

SOIL CLASSIFICATION CHART AND LOG KEY

ESK
ASSOCIATES



BSK Associates
550 W. Locust Ave.
Fresno, CA 93650
Telephone: 559-497-2880
Fax: 559-497-2886

Project: Tulare Industrial WWTP Dewatering

Page 1 of 1

Location: 1875 S West Street, Tulare, CA 93274

Project No.: G19-314-11F

Logged By: S. Jue

Checked By: N. Popenoe

Boring: B-1

Depth (Feet)	Samples	Bulk Samples	Penetration Blows / Foot	In-Situ Dry Density (pcf)	In-Situ Moisture Content (%)	% Passing No. 200 Sieve	Graphic Log	USCS	MATERIAL DESCRIPTION	REMARKS
1								GM	Silty GRAVEL - brown, moist, fine to medium grained sand, fine to coarse grained gravel, subangular and subrounded	
2				107.7	7.2	31		SM	Silty SAND - brown, moist, fine to medium grained sand, strongly cemented	$\phi = 35^\circ$, $c = 0$ psf
3										
4										
5									... trace clay	
6										
7										
8										
9										
10								CL	Sandy CLAY - brown, moist, fine grained sand	
11									Boring terminated at approximately 10 feet bgs. No groundwater encountered. Boring backfilled with soil cuttings.	
12										
13										
14										
15										
16										
17										
18										
19										

Drilling Contractor: BSK Associates
Drilling Method: Hand Auger
Drilling Equipment: Hand Auger
Date Started: 12/30/19
Date Completed: 12/30/19

Surface Elevation:
Sample Method: 2.5" Modified Cal
Groundwater Depth: Not Encountered
Completion Depth: 10 Feet
Borehole Diameter: 4"

* See key sheet for symbols and abbreviations used above.



BSK Associates
550 W. Locust Ave.
Fresno, CA 93650
Telephone: 559-497-2880
Fax: 559-497-2886

Project: Tulare Industrial WWTP Dewatering

Page 1 of 1

Location: 1875 S West Street, Tulare, CA 93274

Project No.: G19-314-11F

Logged By: S. Jue

Checked By: N. Popenoe

Boring: B-2

Depth (Feet)	Samples	Bulk Samples	Penetration Blows / Foot	In-Situ Dry Density (pcf)	In-Situ Moisture Content (%)	% Passing No. 200 Sieve	Graphic Log	USCS	MATERIAL DESCRIPTION	REMARKS
1								GM	Silty GRAVEL - brown, moist, fine to medium grained sand, fine to medium grained gravel	
2								SM	Silty SAND - brown moist, fine to medium grained sand	
3										
4										
5									... fine grained sand	
6										
7										
8										
9										
10										
11										
12								CL	Sandy CLAY - light brown, moist, fine grained sand	
13									Boring terminated at approximately 12 feet bgs. No groundwater encountered. Boring backfilled with soil cuttings.	
14										
15										
16										
17										
18										
19										

Drilling Contractor: BSK Associates
Drilling Method: Hand Auger
Drilling Equipment: Hand Auger
Date Started: 12/30/19
Date Completed: 12/30/19

Surface Elevation:
Sample Method: 2.5" Modified Cal
Groundwater Depth: Not Encountered
Completion Depth: 12 Feet
Borehole Diameter: 4"

* See key sheet for symbols and abbreviations used above.

APPENDIX B

LABORATORY TESTING RESULTS



APPENDIX B

LABORATORY TESTING RESULTS

The results of laboratory testing performed in conjunction with this project are contained in this Appendix. The following laboratory tests were performed on soil samples in general conformance with applicable standards.

Moisture-Density Tests

The field moisture content, as a percentage of dry weight of the soils, was determined by weighing the samples before and after oven drying in accordance with ASTM D2216 test procedures. Dry densities, in pounds per cubic foot, were also determined for undisturbed core samples in general accordance with ASTM D2937 test procedures. Test results are presented on the Boring logs in Appendix A.

Sieve Analysis Test

One (1) Sieve Analysis Tests were performed on selected soil samples in the area of planned construction. The tests were performed in general accordance with Test Method ASTM D1140. The results of the tests are presented on Figure B-1.

Expansion Index Test

One (1) Expansion Index Test was performed on a bulk soil sample of the upper 5 feet of material obtained at the time of drilling in the area of planned construction to determine the expansion characteristics of the sample. The test was performed in general accordance with UBC Standard 18-2/ASTM Test Method D4829. The test results are presented on Figure B-2.

Direct Shear Test

One (1) Direct Shear Tests were performed on relatively undisturbed soil samples obtained at the time of drilling in the area of planned construction. The tests were conducted to determine the soil strength characteristics. The standard test method used is ASTM D3080, Direct Shear Test for Soil under Consolidated Drained Conditions. The direct shear test results are presented graphically on Figure B-3.



Soil Corrosivity

One (1) Corrosivity Evaluations were performed on bulk soil samples obtained at the time of excavating in the area of planned construction. The soil was evaluated for minimum resistivity and pH (CT 643), sulfate ion concentration (CT 417), and chloride ion concentration (CT 422). The test results are presented in Table B-1.

Table B-1: Summary of Corrosion Test Results				
Sample Location	pH	Sulfate, mg/kg	Chloride, mg/kg	Minimum Resistivity, ohm-cm
B-1 @ 0-5 feet bgs	8.1	110	22	1170



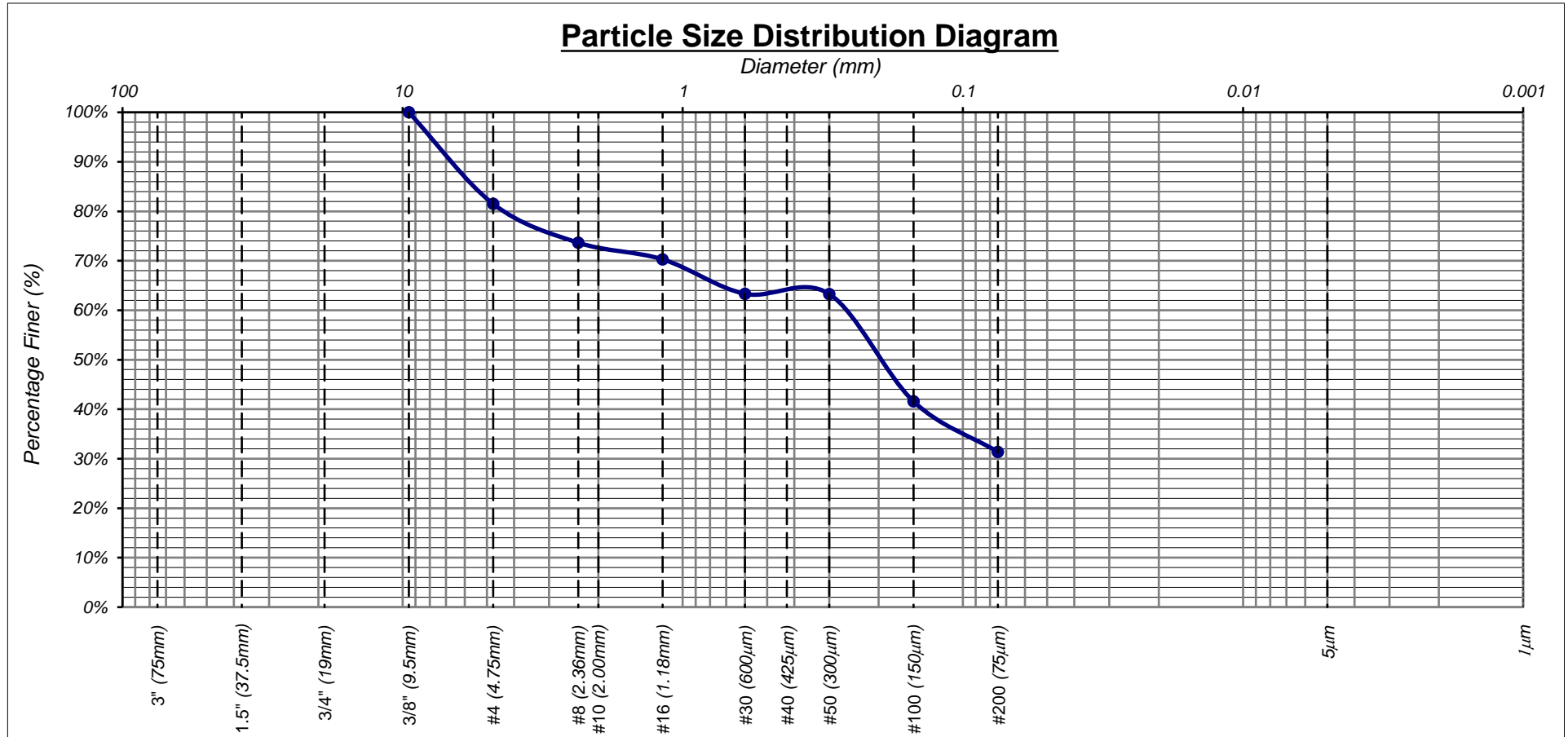


Gradation Analysis Report ASTM D-422 / ASTM C-136

FIGURE B-1

550 W. Locust Ave.
Fresno, CA 93650
Ph: (559) 497-2880
Fax: (559) 497-2886

Project Name:	Tulare Industrial WWTP	Project Number:	G19 - 314 - 11F	Report Date:	1/7/2020
Sample Location:	B - 1 @ 0 - 5'	Sample Lab ID:	NA	Sample Date:	12/30/2019
Sample Description:	Silty Sand with Gravel (SM) brown, moist, fine to coarse grained			Test Date:	1/6/2020



	Clear Square Openings (ASTM C-136)		US Standard Series (ASTM D-422)			Hydrometer Readings (ASTM D-422)
	Gravel		Sand			Silt (Non-Plastic) to Clay (Plastic)
	Coarse	Fine	Coarse	Medium	Fine	

% Gravel = 19%

% Sand = 50%

% Fines = 31%



Expansion Index of Soils
ASTM D 4829 / UBC Standard 18-2

FIGURE B-2

550 W. Locust Avenue
Fresno, CA 93650
Ph: (559) 497-2868
Fax: (559) 485-6140

Project Name: Tulare Industrial WWTP **Report Date:** 1/7/2020
Project Number: G19 - 314 - 11F **Sample Date:** 12/30/2019
Lab Tracking ID: NA **Test Date:** 1/6/2020
Sample Location: B - 1 @ 0 - 5'
Sample Source: Auger Cuttings
Sampled By: S.Jue **Tested By:** Dmessin **Reviewed By:** NMP

TEST DATA

INITIAL SET-UP DATA			
Sample + Tare Weight (g)	721.8		
Tare Weight (g)	303.8		
Moisture Content Data		Moisture Content Data	
Wet Weight + Tare	100.0	Wet Weight + Tare	280.9
Dry Weight + Tare	92.6	Dry Weight + Tare	244.2
Tare Weight (g)	0	Tare Weight (g)	16.4
Moisture Content (%)	8.0%	Moisture Content (%)	16.1%
Initial Volume (ft ³)	0.007272	Final Volume (ft ³)	0.007303
Remolded Wet Density (pcf)	126.7	Final Wet Density (pcf)	135.7
Remolded Dry Density (pcf)	117.3	Final Dry Density (pcf)	116.8
Degree of Saturation	50	Degree of Saturation	99

EXPANSION READINGS

Initial Gauge Reading (in)	0.0744
Final Gauge Reading (in)	0.0786
Expansion (in)	0.0042

Uncorrected Expansion Index	4
Corrected Expansion Index, EI	4

Classification of Expansive Soil

EI	Potential Expansion
0 - 20	Very Low
21 - 50	Low
51 - 90	Medium
91 - 130	High
>130	Very High



Direct Shear Test

ASTM D-3080

FIGURE B-3

550 W. Locust
Fresno, CA 93650
Ph: (559) 497-2880
Fax: (559) 497-2886

Project Name:	Tulare Industrial WWTP	Sampled By:	S.Jue	Sample Date:	12/30/2019
		Tested By:	D.Messin	Test Date:	1/7/2020
Project Number:	G19-314-11F	Lab Tracking ID:	N/A	Report Date:	1/7/2020
Sample Location:	B-1 @ 2.5'	Sample Description:	Silty SAND (SM) - brown, fine to medium grained sand		

SHEAR STRENGTH DIAGRAM

